MANUAL OF GUIDELINES AND STANDARDS

GENERAL INTRODUCTION

The Massachusetts Bay Transportation Authority has found it both necessary and possible to concentrate attention on the complex needs of people. Programs to improve service must now include a new emphasis on the quality of the transportation experience. In effect, transportation engineering has been joined by human engineering and environmental design.

This manual provides a framework for the continued coordination of all those elements in the system that affect human comfort.

Many of the criteria involved are common to all environments, such as the control of light, noise, humidity, temperature, wind, and odors, or the need for orderliness, through clear and easy circulation and clean appearance. Other criteria that are more specific to the transportation environment are such needs as safety, traffic handling capability, spatial variety, consistently available information, and orientation.

The most important single criterion that has guided the preparation of this manual is the need for orientation. The rider must not only be physically comfortable, he must also know in the fullest sense where he is and where he is going.

Since to the layman a public transportation system is to a large extent an invisible skeleton of the city and metropolitan region, the comprehension of that structure generates an awareness and appreciation of the city itself, and an appreciation of travel through it.

There are many aspects to achieving this orientation. Circulation at all points must be direct and open. Spaces should relate visually to their surrounding environment, either through direct openings to adjacent spaces and structures, or in the case of platforms, by graphic reflection through photographic murals.

Above all, the need for orientation places great emphasis on maps and a consistent system of identification and directional signing. Graphics then emerges as a major factor in the design of each environment, a factor that must be given high priority in the early design phases of each project.

It is hoped that all participants in all programs will familiarize themselves with the entire manual, so that the implications of each decision can be understood in a system-wide context.

The standards and guidelines presented here are not inflexible rules. They are a framework for meaningful development and variety, and offer no restriction to the capacity of each participant to evolve better solutions to old or new problems.

As new solutions are developed and approved, revised and additional pages for the manual will be issued to all participants.

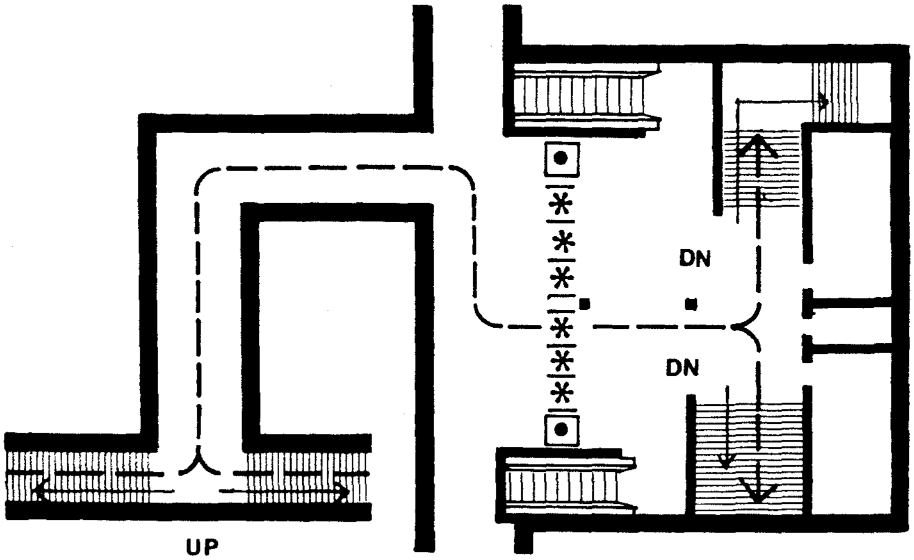
Part I of the Manual illustrates certain defects in the present station environment and establishes principles through which improvement may be achieved, as part of the Station Modernization Program. It further sets down various demensional standards and limitations pertaining to each of the existing lines.

Further general guidelines will be added to this Part, regarding the new stations.

INTRODUCTION

SYMBOL KEY

⊡	Change Booth
|*|	Entrance Turnstile
✸	Passimeter
✸	Exit Gate
⊥⊥⊥	Graphics
	Advertising
- - →	Entrance Circulation
## →	Exiting Circulation



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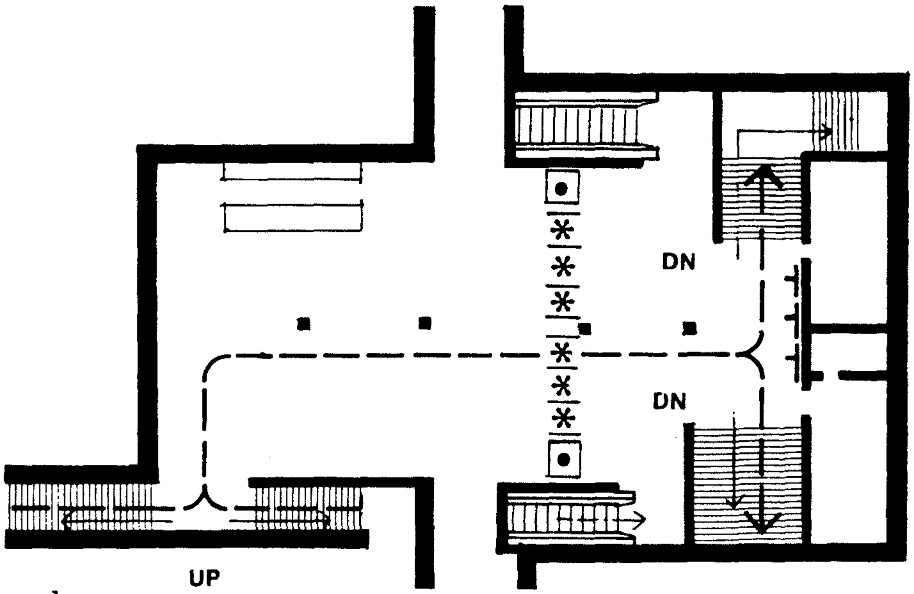
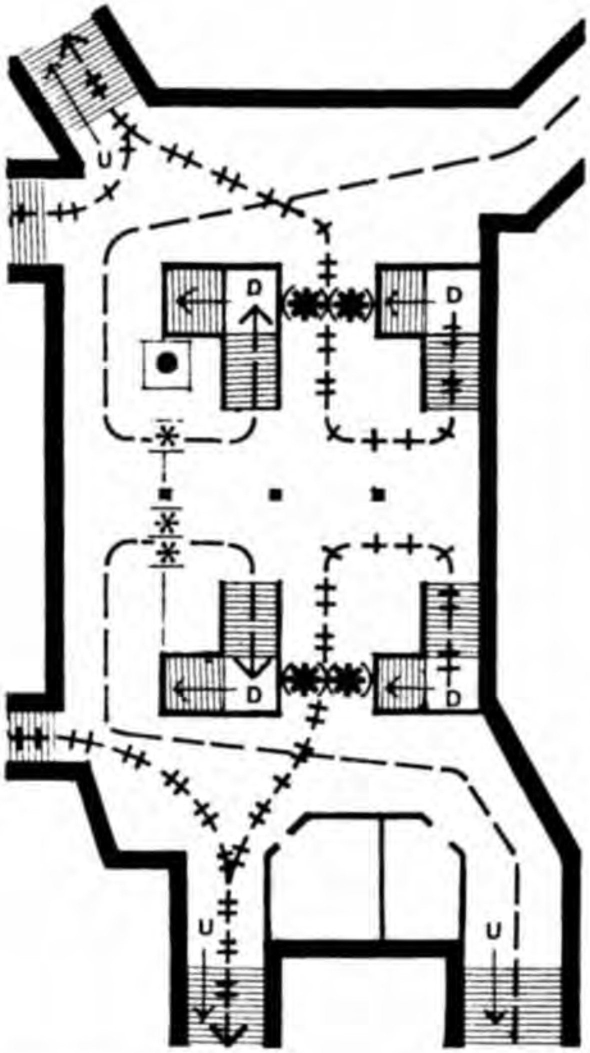


Proposed

Clarify circulation by eliminating unnecessary and disorienting turns.

Example used: Kenmore

DIRECT CIRCULATION



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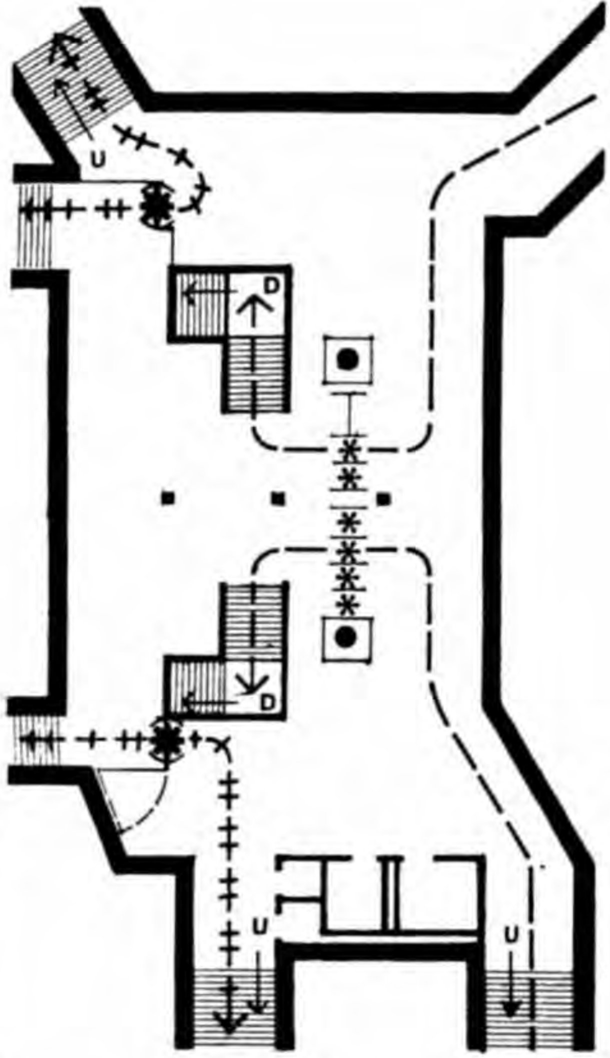
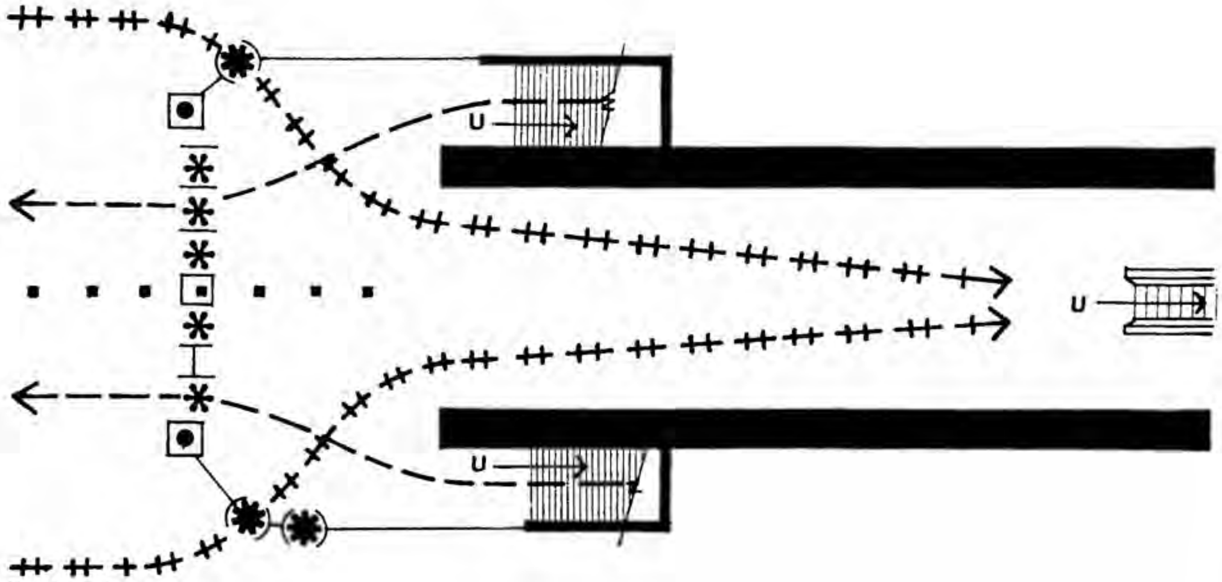


Proposed

Improve circulation by providing adequate space to eliminate bottlenecks.

Example used: Arlington

DIRECT CIRCULATION



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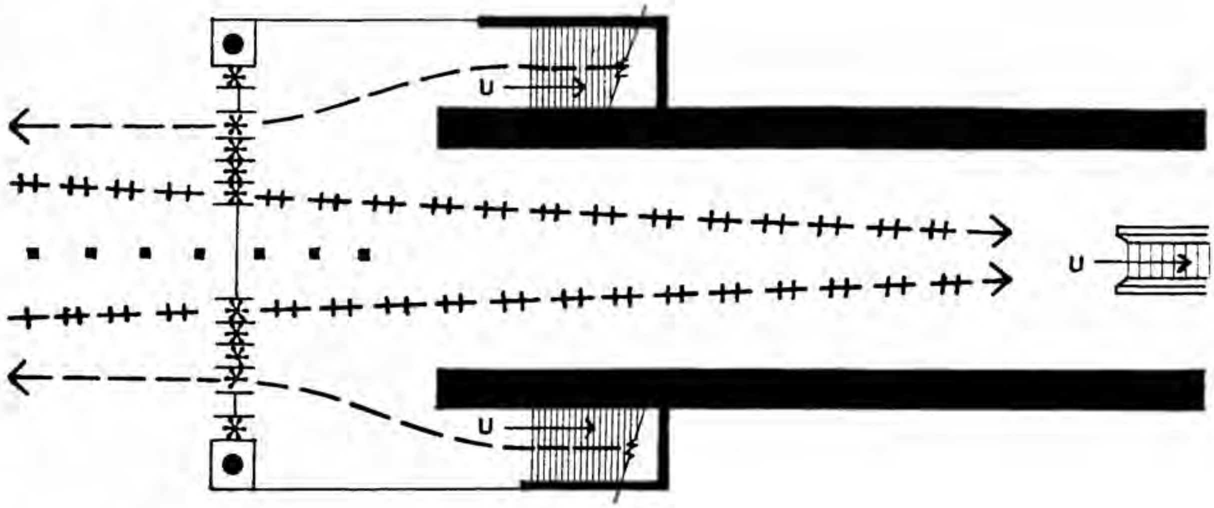
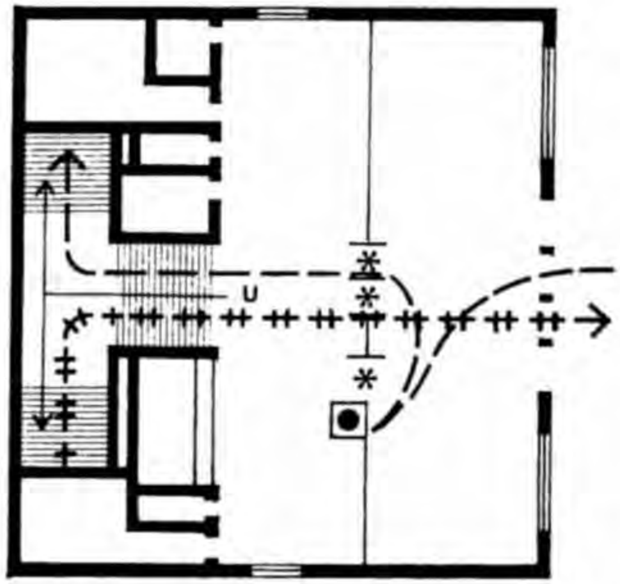


Proposed

Relocate fare collection components to avoid cross circulation at constricted decision points.

Example used: Maverick

CROSS CIRCULATION



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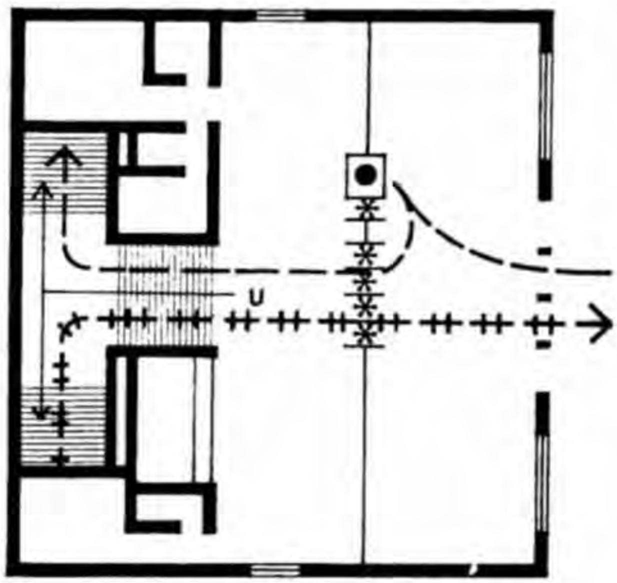
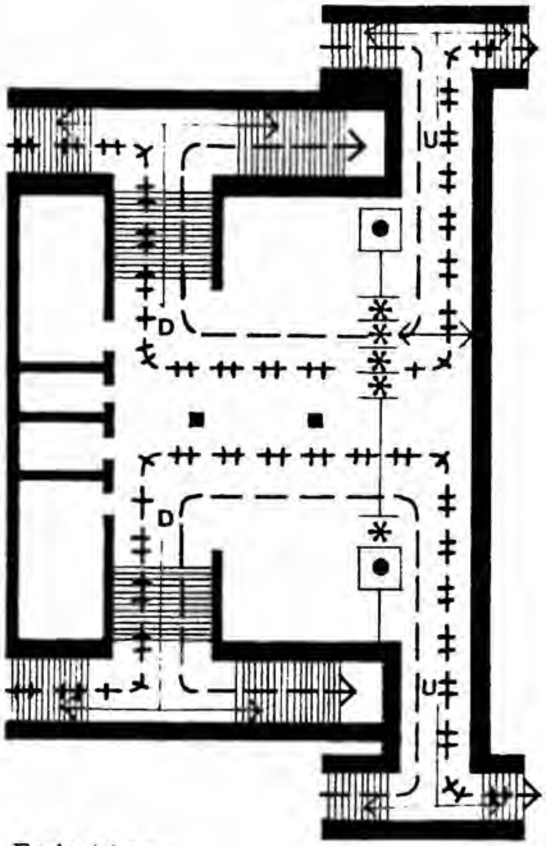


Proposed

Provide right hand circulation, by relocation of change booth.

Example used: Beachmont

<u>RIGHT HAND CIRCULATION</u>



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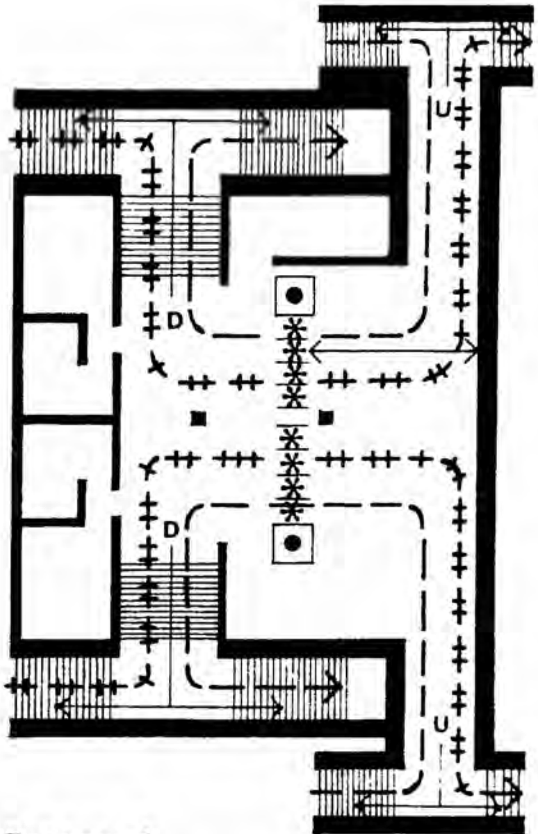
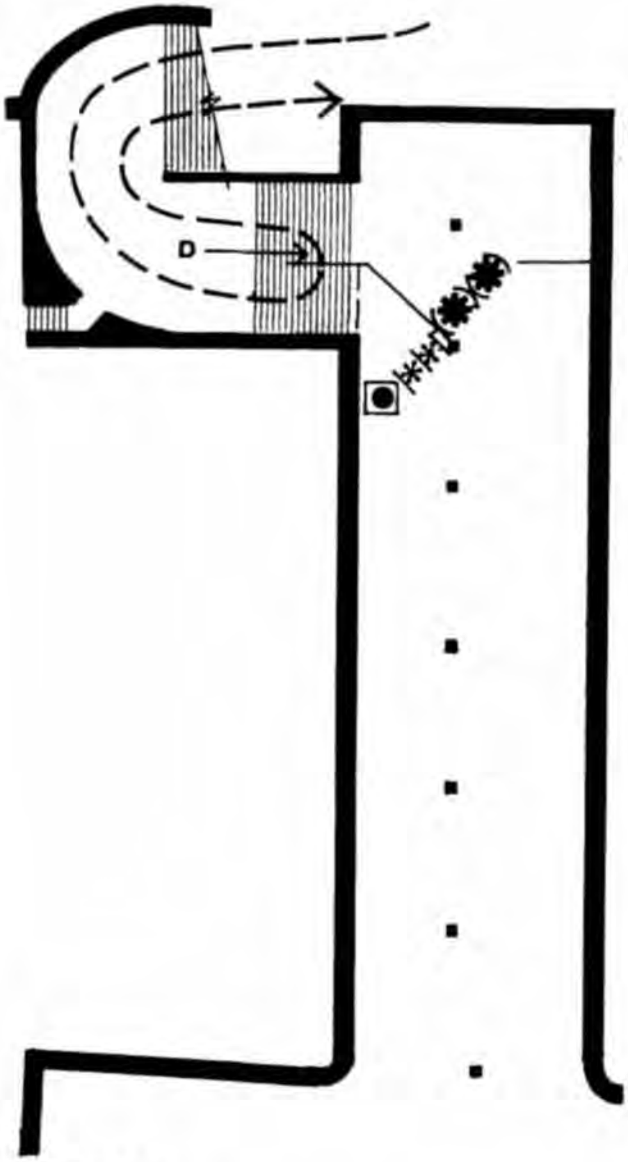


Proposed

Provide adequate space in mezzanines and entrance lobbies for queuing outside fare collection.

CIRCULATION SPACE



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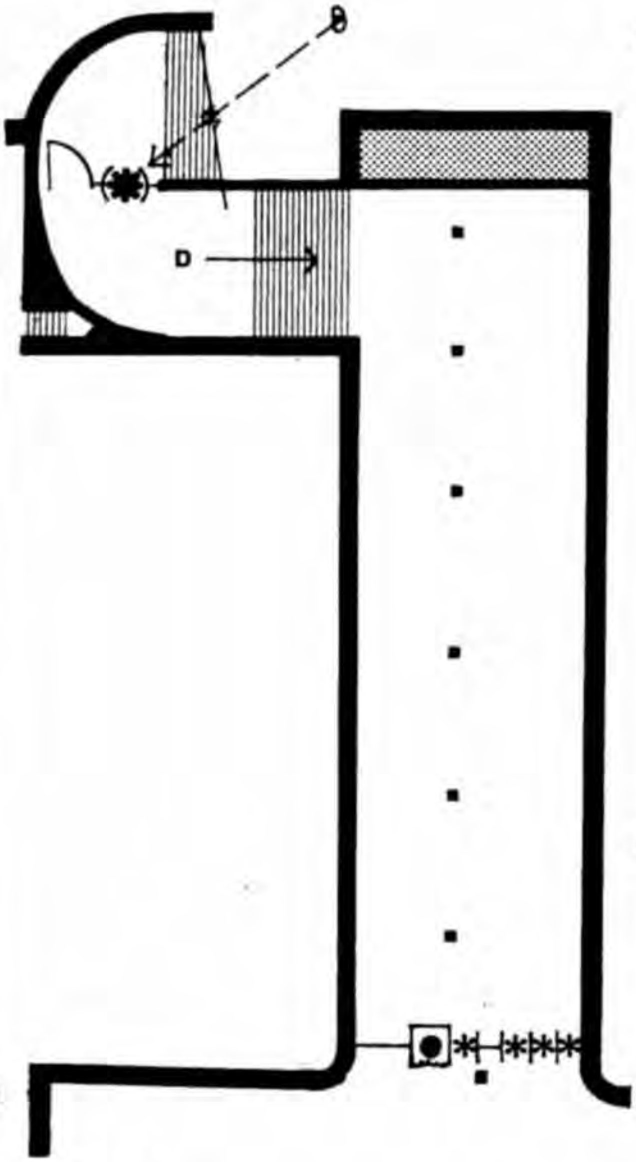
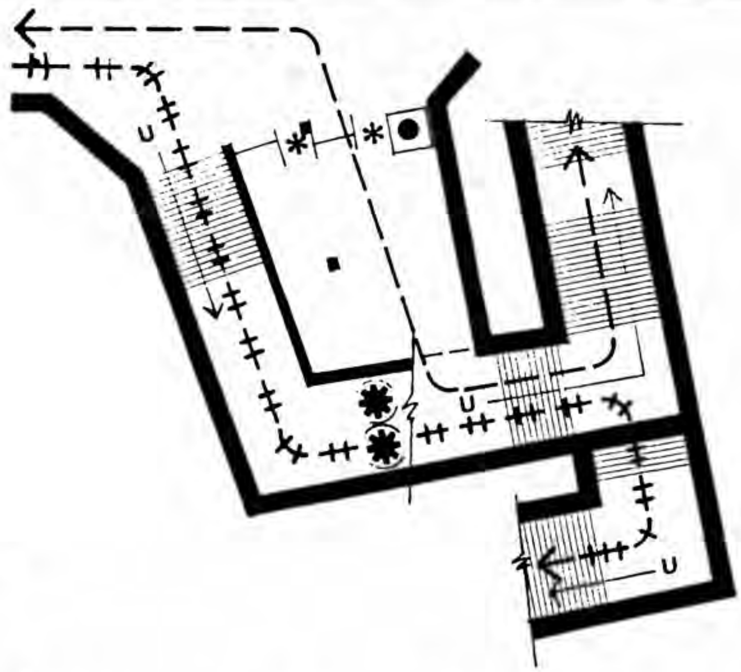


Proposed

Relocate exit barriers to be visible from street so as to minimize frustrated entry attempts.

Example used: Essex

FRUSTRATED ENTRY



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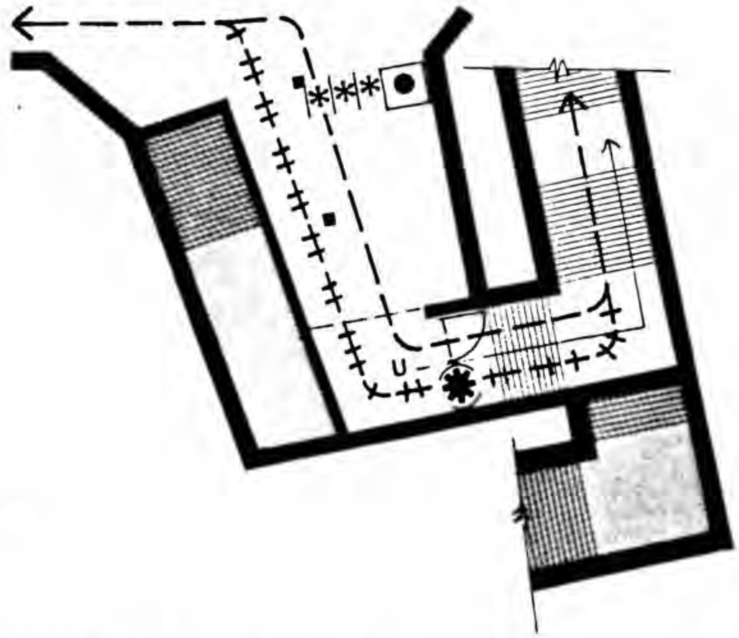
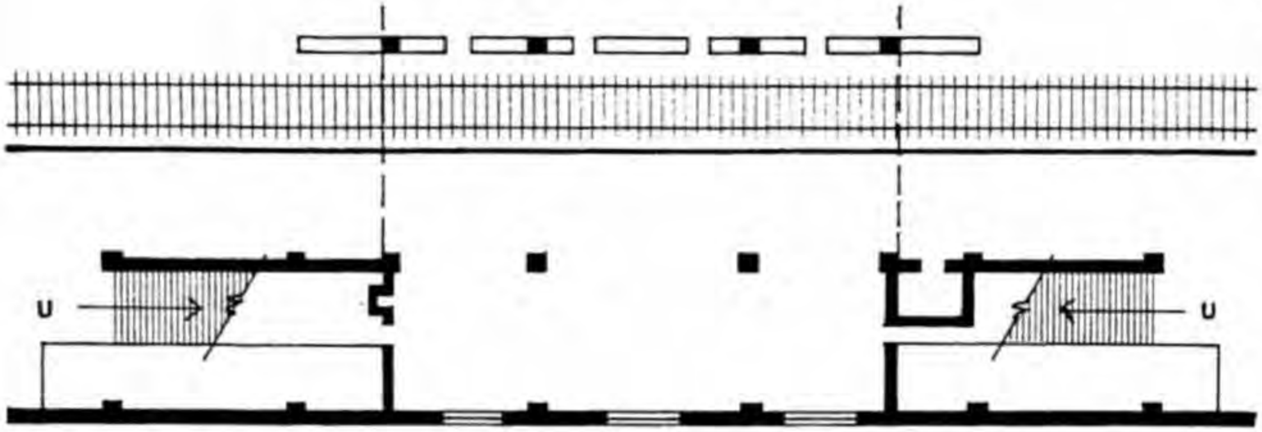


Proposed

Clarify circulation by eliminating useless options, and where space is adequate, by combining entrance and exit circulation.

Example used: Essex

USELESS OPTIONS



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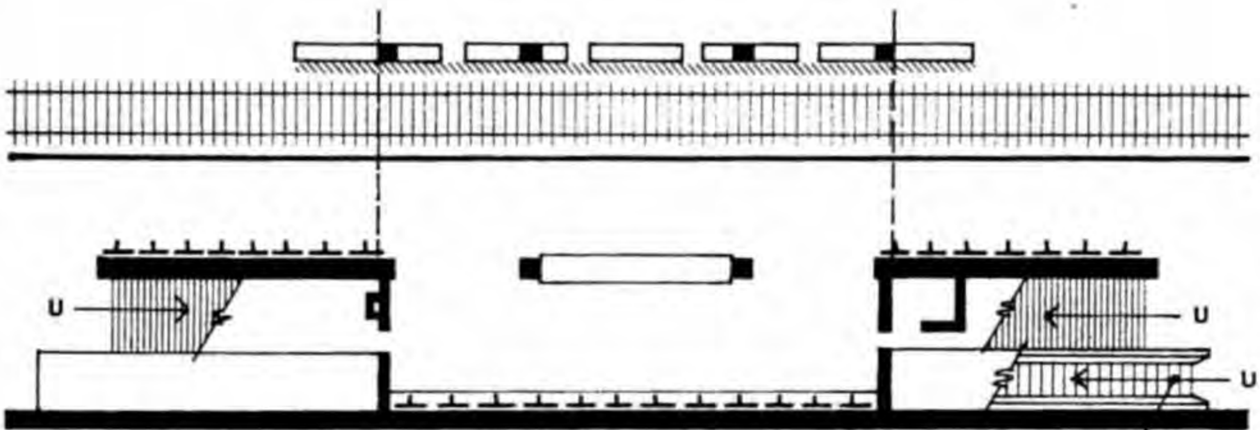


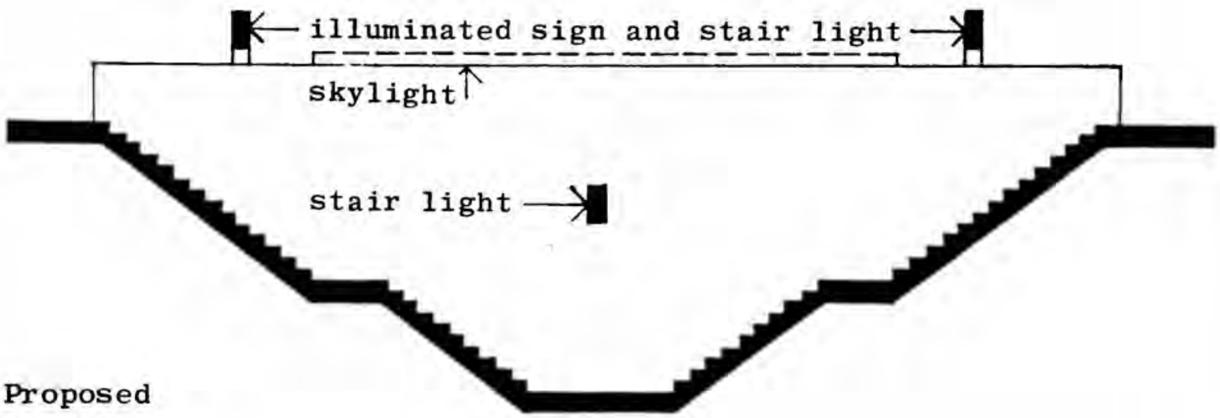
Proposed

Provide escalators, whenever possible.

Example used: Airport

ESCALATORS

Existing

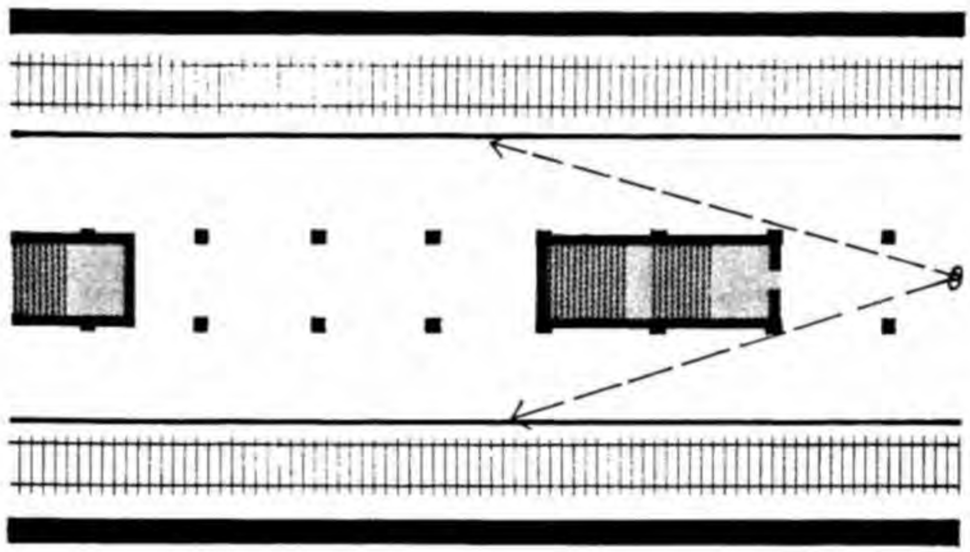


Proposed

Open double entrance stairs to daylight, where possible. Reduction in sidewalk area will require approval of local traffic authorities.

When roofs are removed, drainage and installation of new means of snow melting must be considered.

OPEN ENTRANCES



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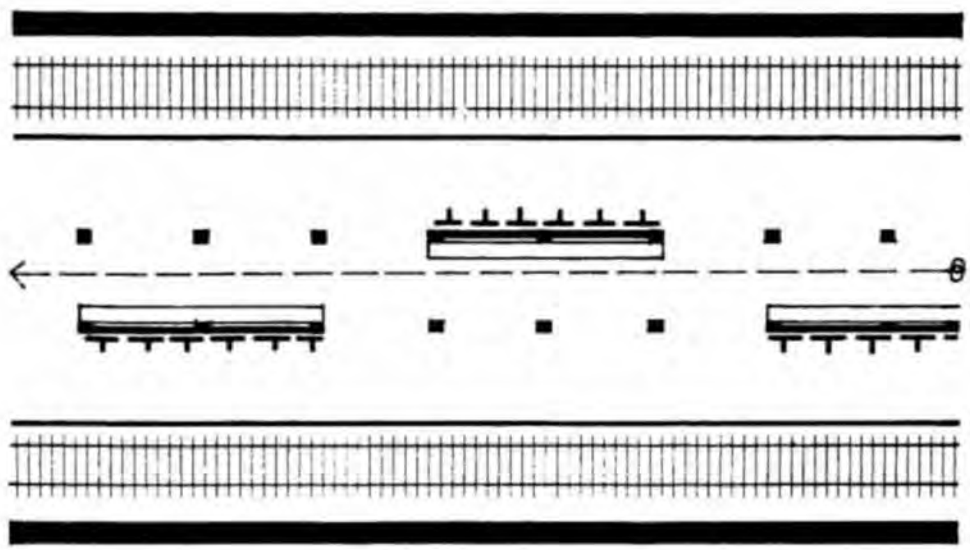
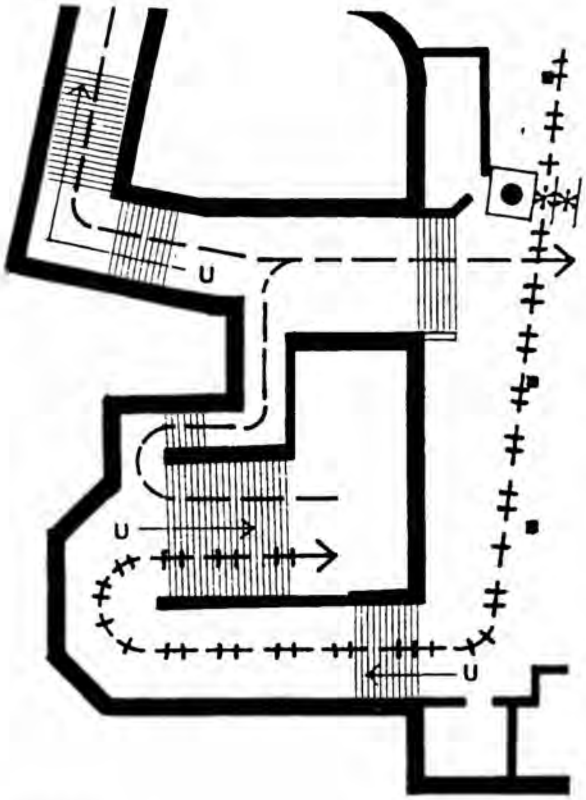


Proposed

Visually open end-loaded platforms to eliminate blind spots, where possible.

Example used: Broadway

PLATFORM OPENNESS



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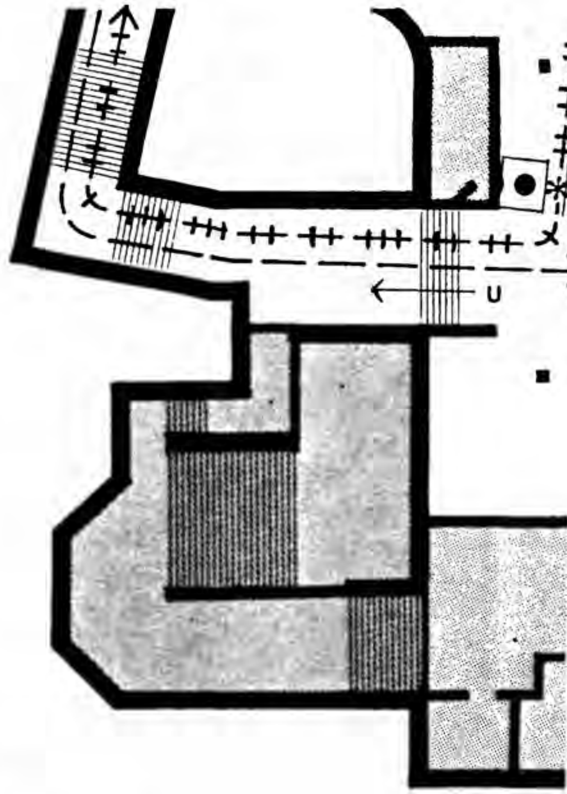
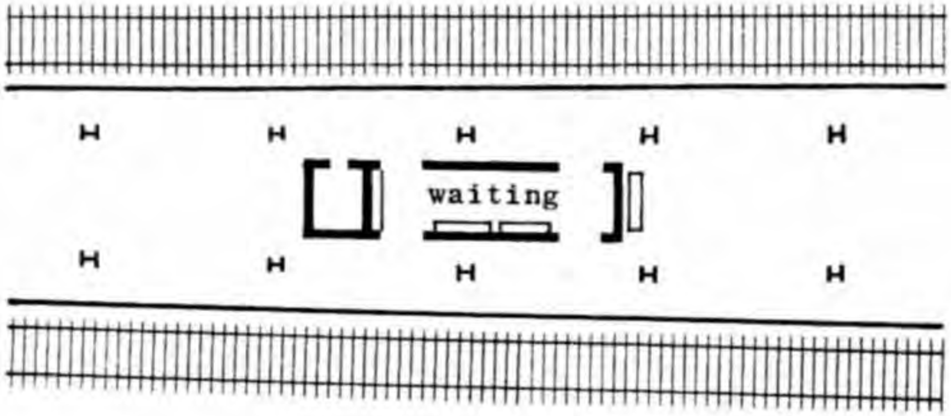


Proposed

Improve circulation spaces by eliminating unsupervisable passageways and stairs, where possible.

Example used: Essex

SURVEILLANCE



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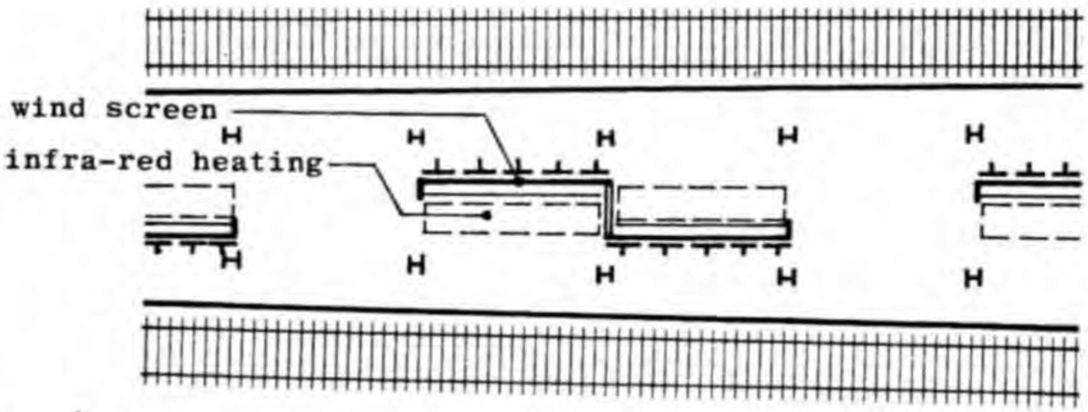
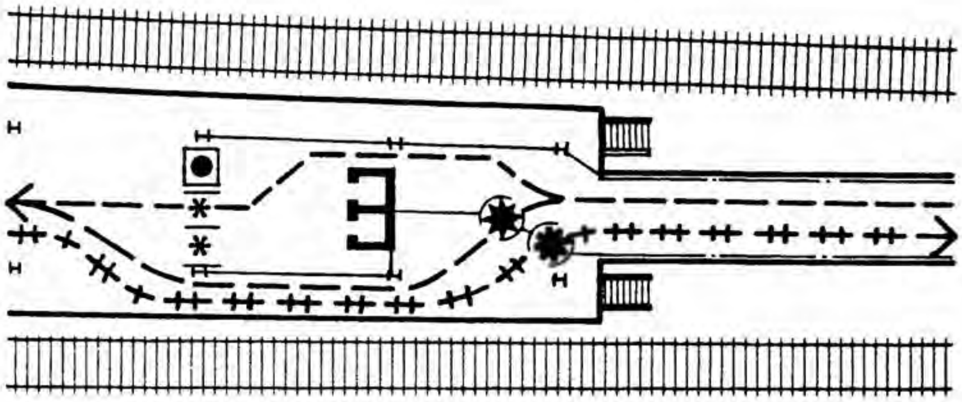


Proposed

Provide open waiting areas, with infra-red heating and wind screens. Eliminate closed waiting rooms which are impossible to supervise.

Example used: Columbia

WAITING AREAS



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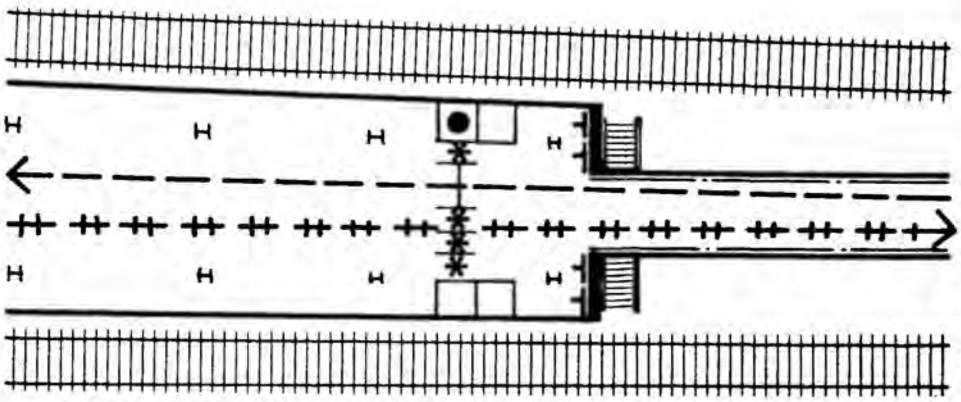
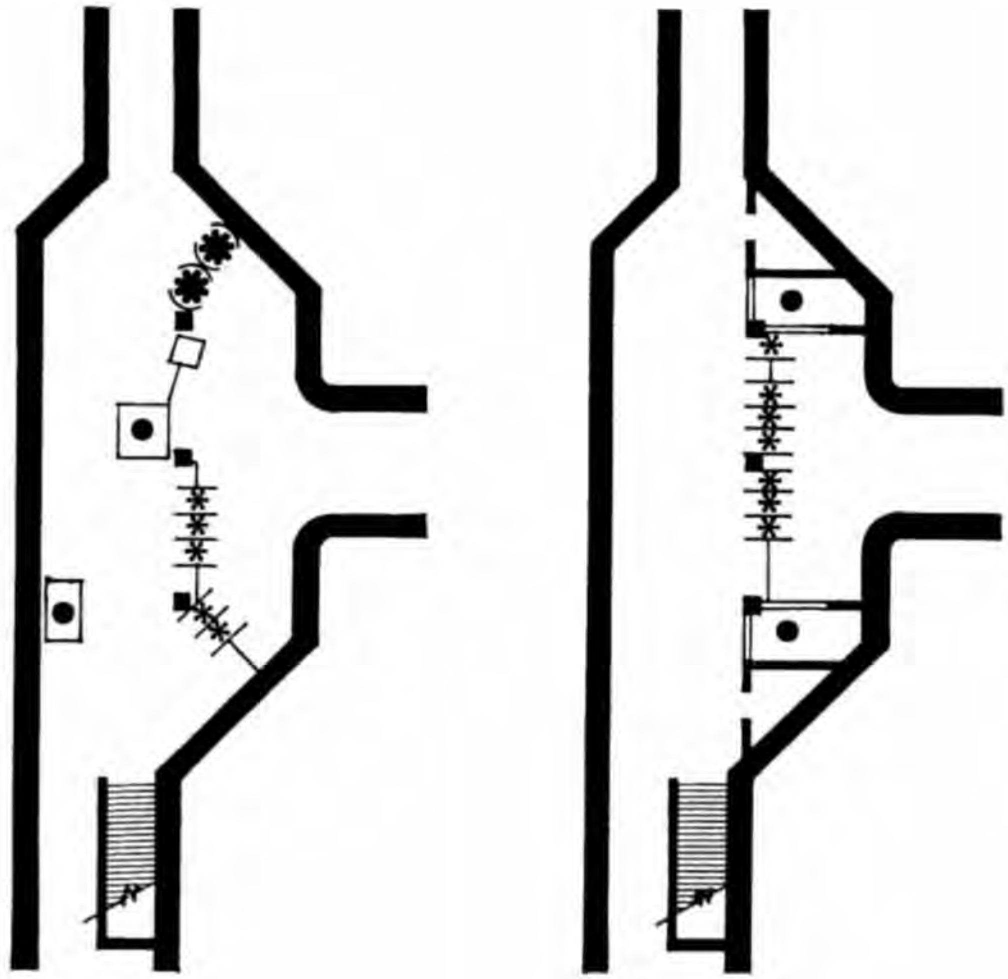


Proposed

Relate freestanding components sympathetically to structure and circulation. Reduce blindspots to ease surveillance.

Example used: Columbia

COMPONENT RELOCATION



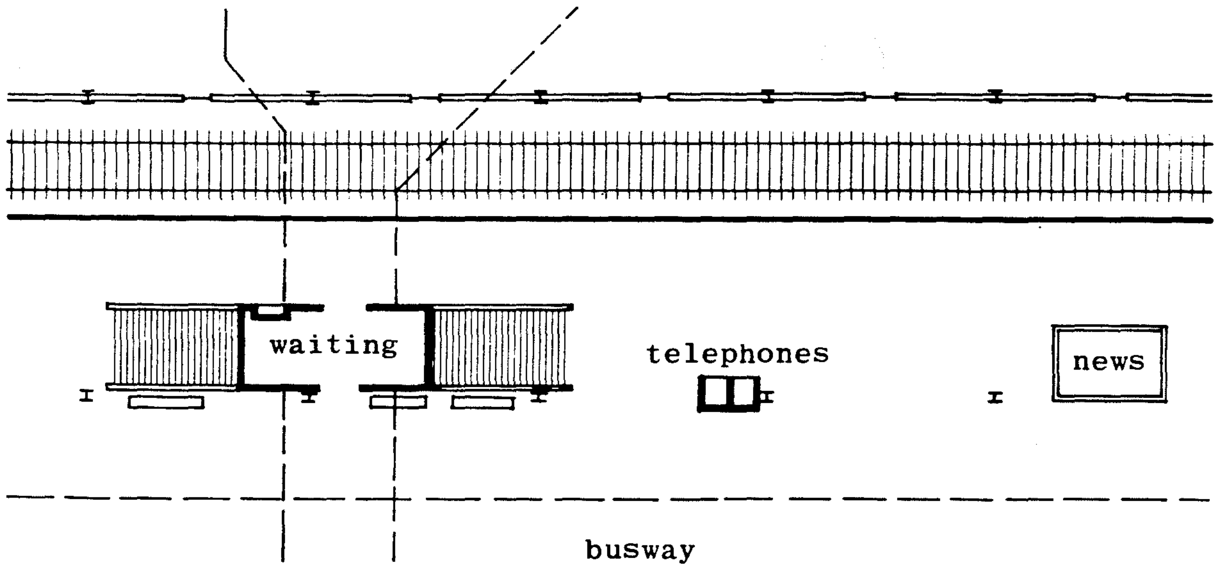
Existing

Proposed

Build-in components, such as change booths, to relate to structure, where appropriate. Reduce clutter in confined areas.

Example used: Arlington

COMPONENT RELOCATION



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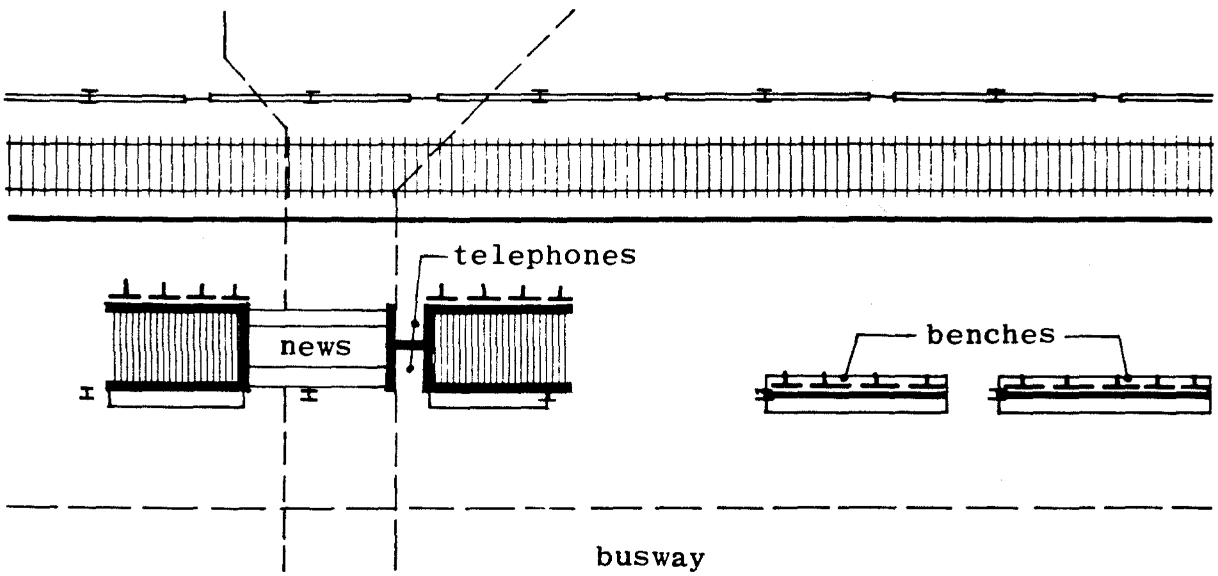
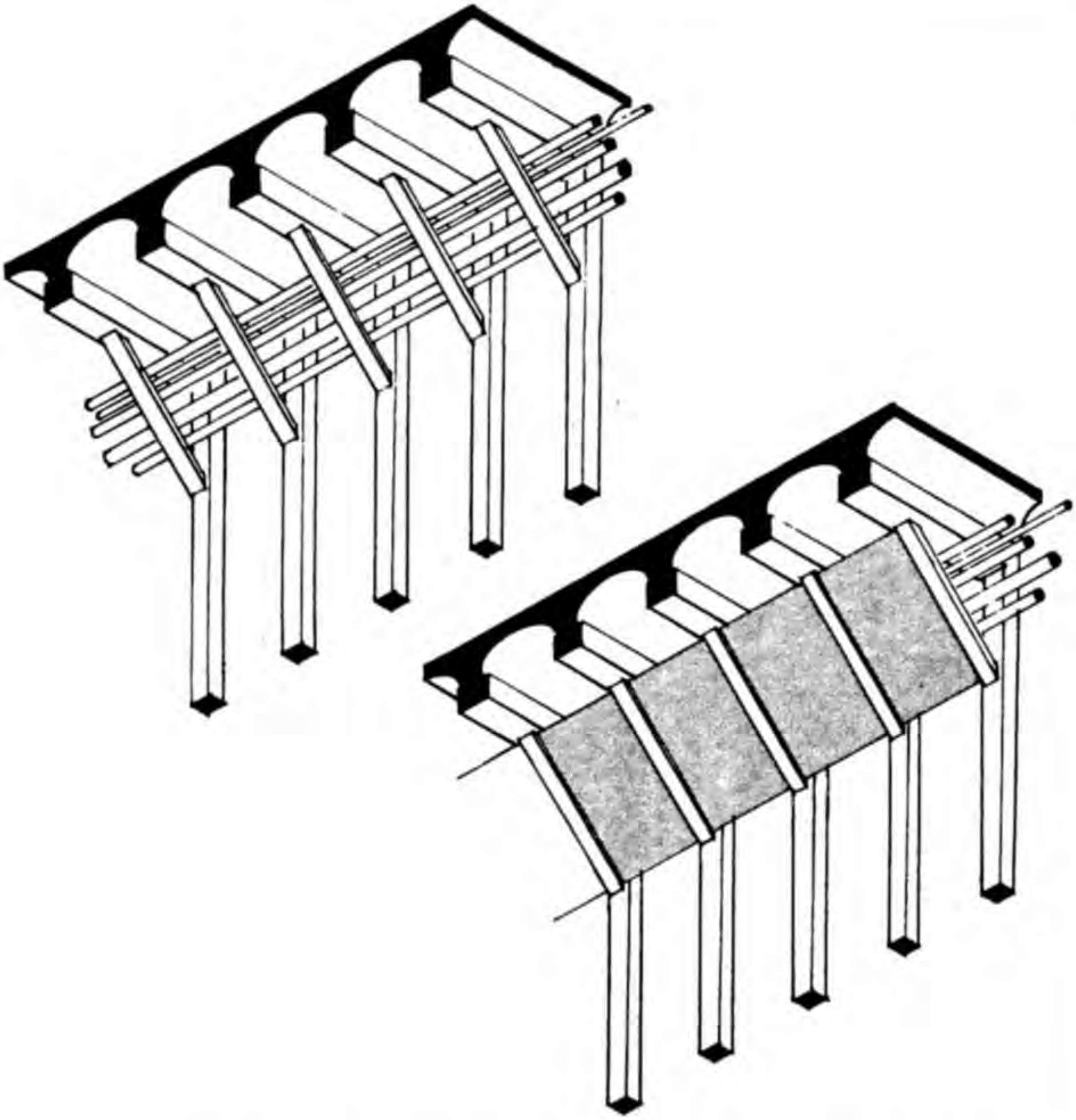


Proposed

Re-locate components to relate to existing structure.

Example used: Field's Corner

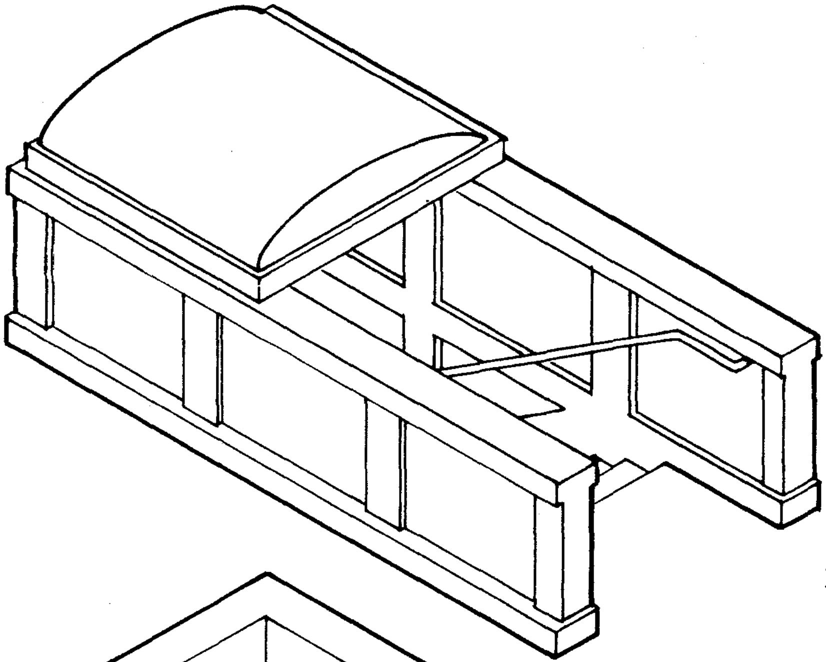
COMPONENT RELOCATION



Cover up exposed runs of conduit, wherever possible, in neat new ducts or chases. When this is not possible, design new conduit and relocate.

Where such covering is provided, it must be adequately vented and drained to prevent collection of gas from leaks and of seepage and condensation. It should be removable for cable access.

SCREENING OF CONDUIT



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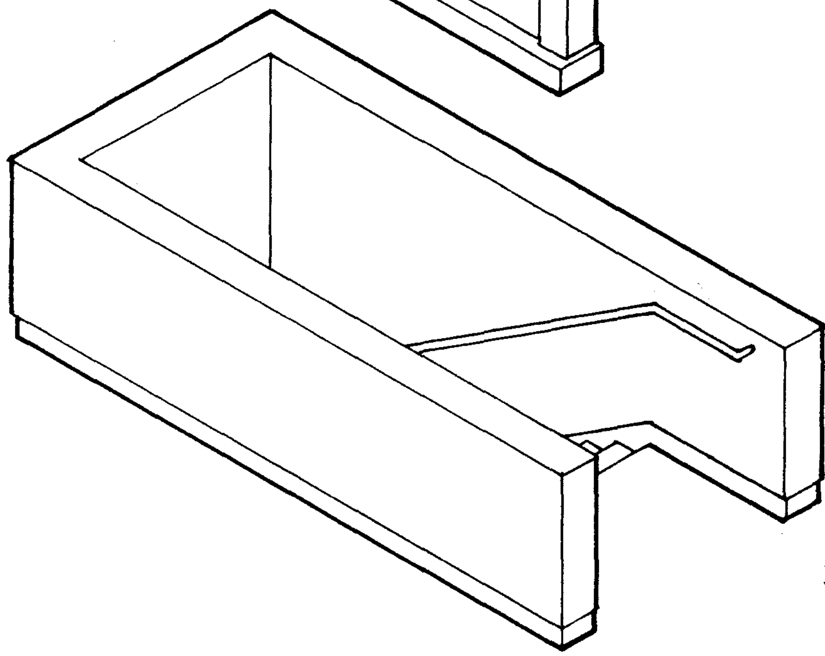
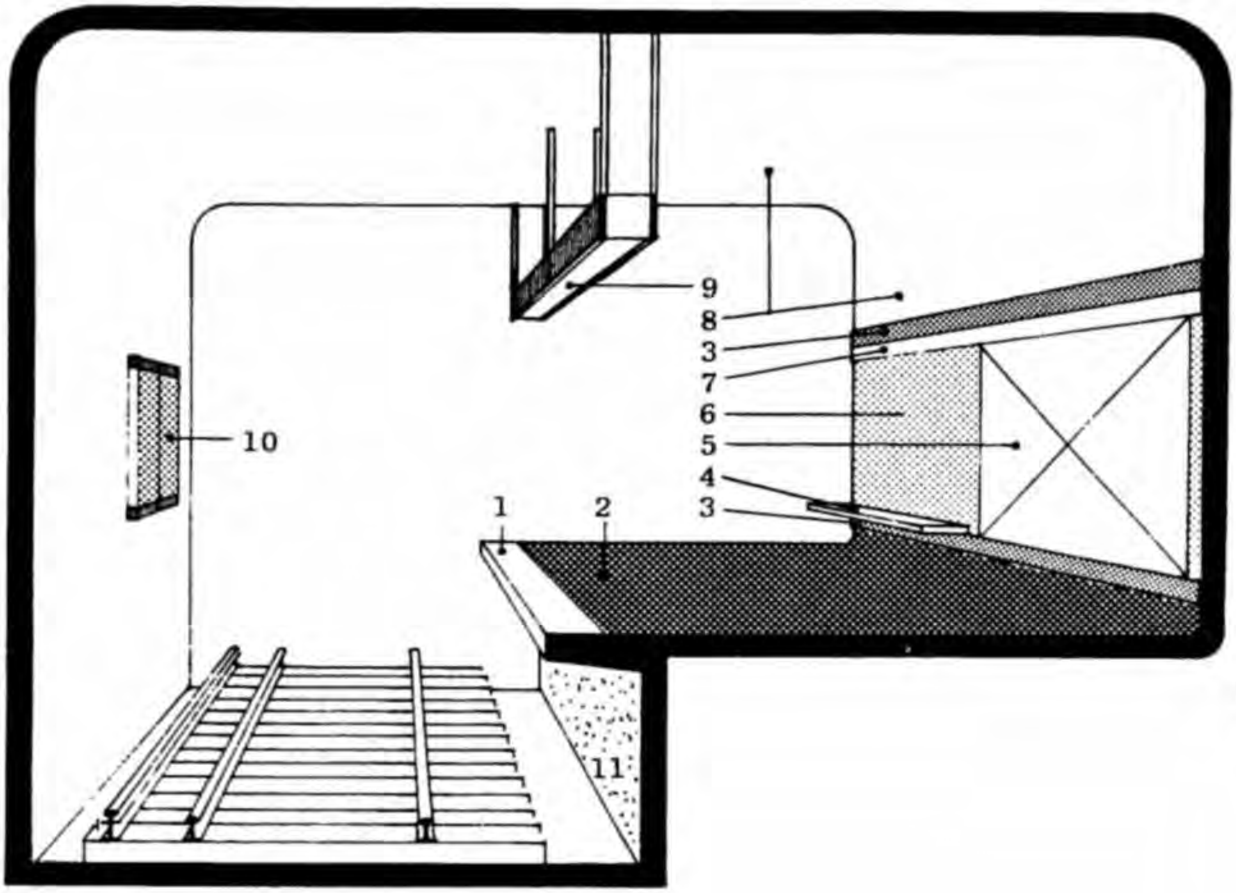


Proposed

Example Used: Arlington

SURFACE STRUCTURE SIMPLIFICATION



1. Yellow safety strip
2. Flooring
3. 9" colored porcelain enamel identity band
4. 3" laminated wood bench
5. Porcelain enamel mural
6. Ceramic tile
7. 6" White porcelain enamel information band
8. White painted walls and ceilings
9. Continuous fluorescent fixture w/ speakers and emerg. lights
10. Advertising frames
11. Acoustic treatment beneath overhang

PRIMARY PLATFORM ELEMENTS

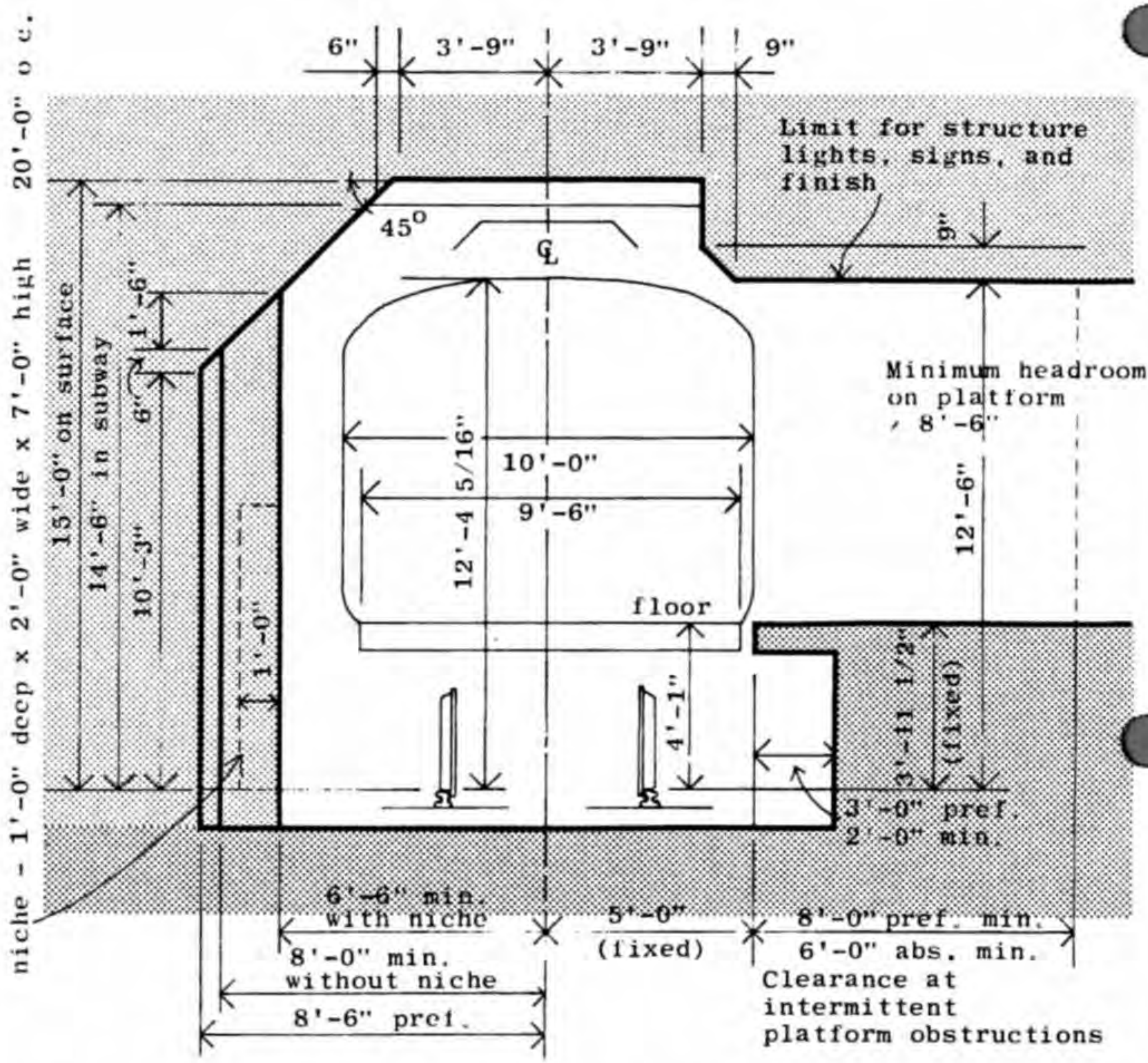
1. Green Line: Existing stations vary from 135' to 440'. Minimum length for 2-3 car trains @ 45'/car plus 30'=300'. Each station should be reviewed with the Authority for special conditions.

2. Red Line: Existing stations vary from 267' to 435'. Stations will be lengthened to allow for 6 car trains @ 70'/car plus 20'=440'. New stations (South Shore and Alewife extensions) should be designed for ultimate use of 8 car trains = 580' though initial construction will be for 6 car trains.

3. Blue Line: Existing stations vary from 187' to 350', which will accommodate 4 car trains @ 50'/car. Ultimately longer trains of larger cars may be necessary so existing platform lengths, and possibility for lengthening should be maintained.

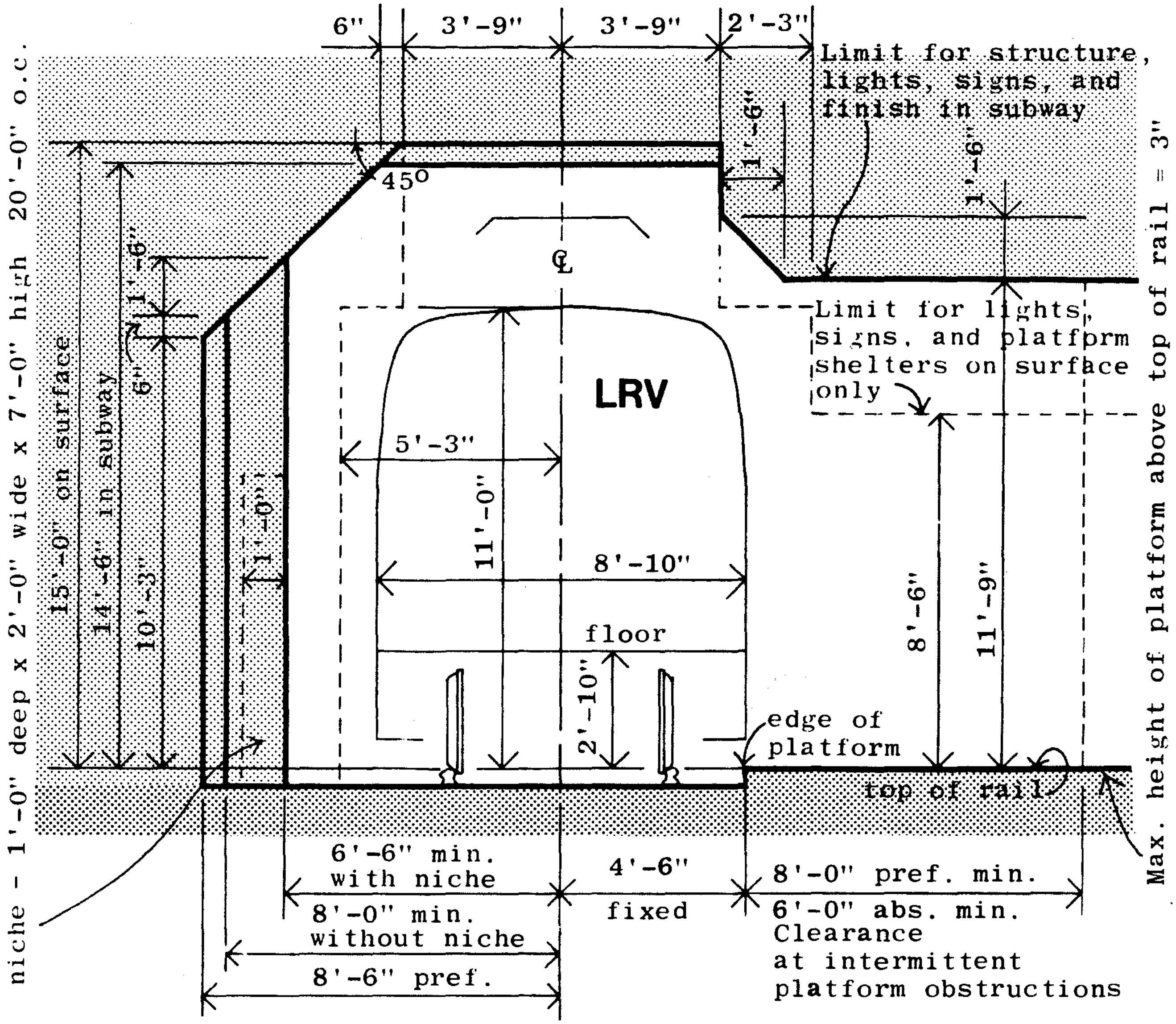
4. Orange Line: Existing stations vary from 305' to 480' and are presently served by 4 car trains @ 55'/car. Existing subway stations will be lengthened, and all new stations (Haymarket-Charlestown, North, and Southwest extensions) designed to allow for 6 car trains @ 65'/car plus 20' = 410'.

PLATFORM LENGTHS



Clearances shown are for new facilities. Existing clearances and absolute minimum clearances for special conditions must be obtained from the MBTA. Track and platform alignment and profile is determined by the engineers in conjunction with the Station Architects and the MBTA. For platform widths see Part IV Components. Structural dimensions shown are minimum unless otherwise noted.

REQUIRED CLEARANCES - Red Line



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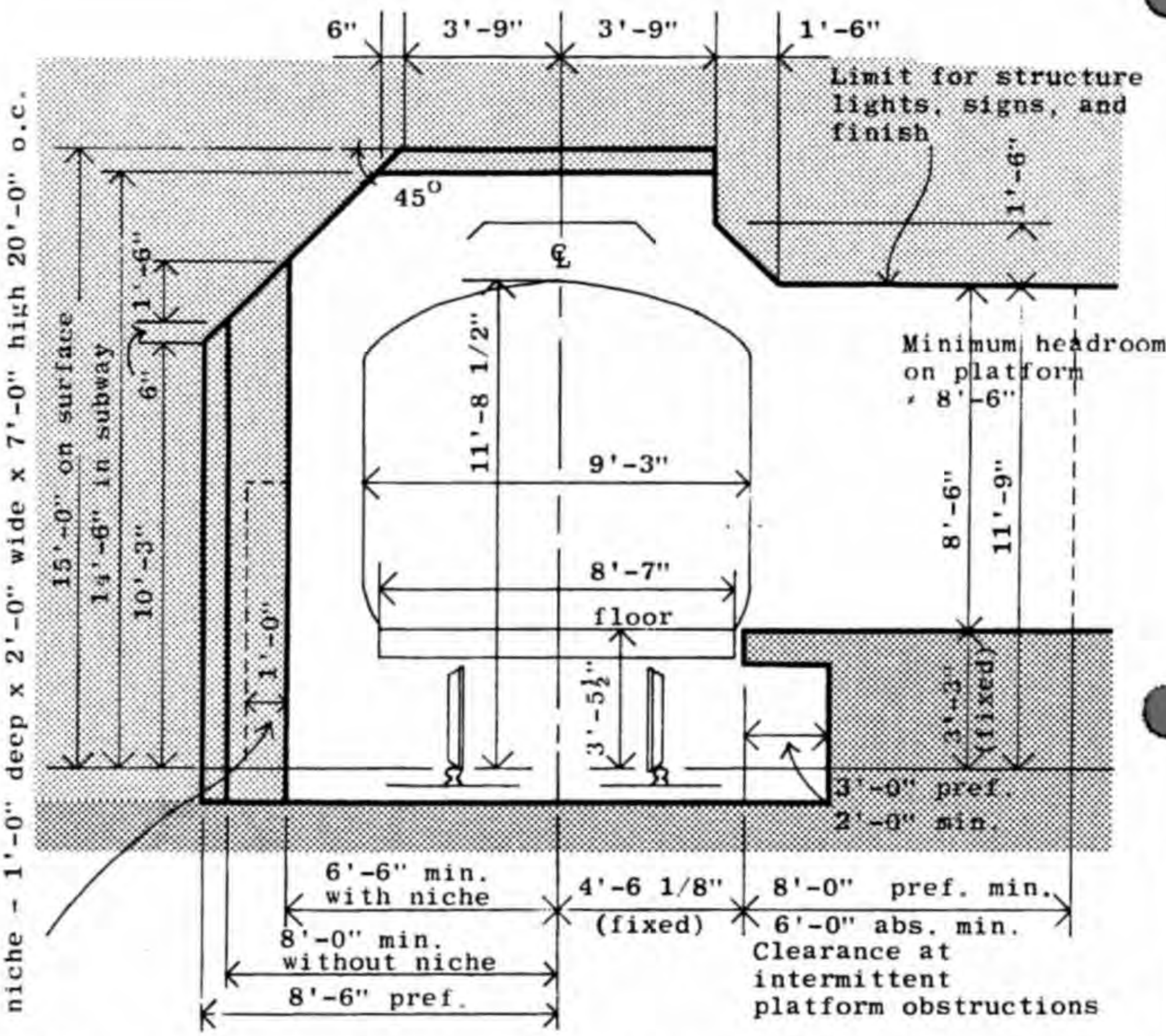
REQUIRED CLEARANCES - Green Line



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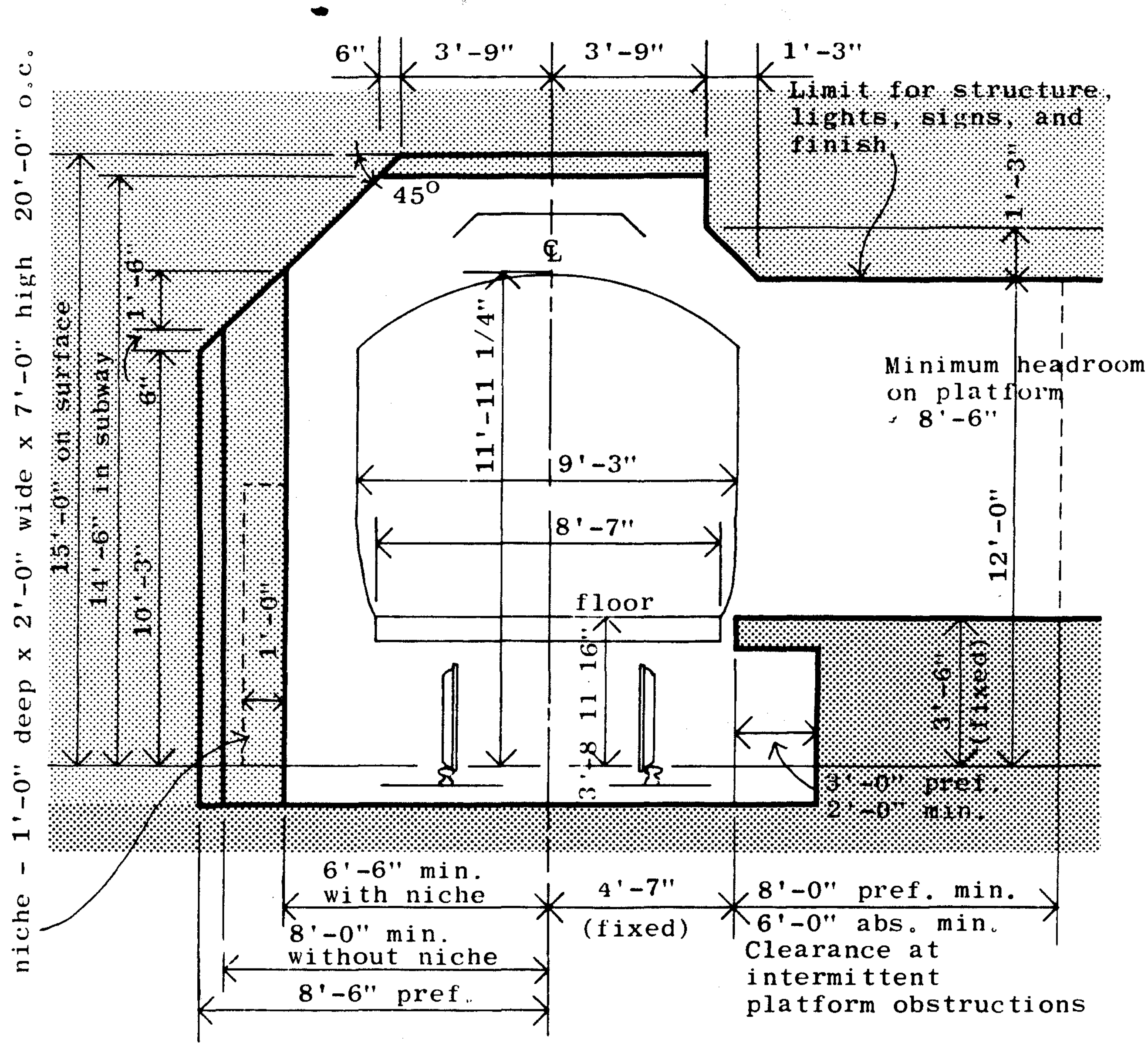
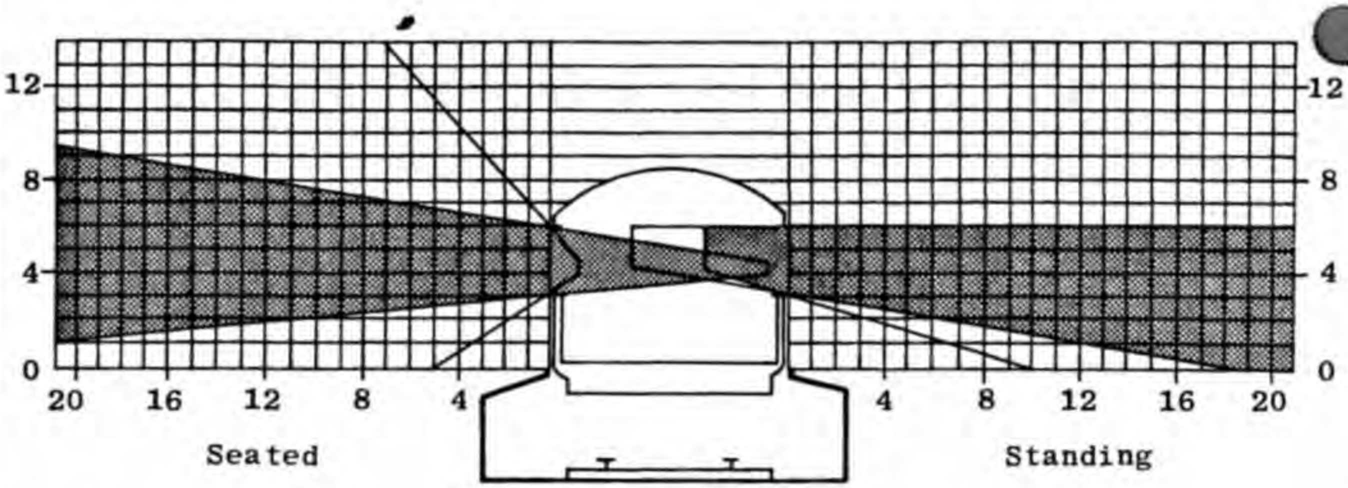
REQUIRED CLEARANCES - Blue Line



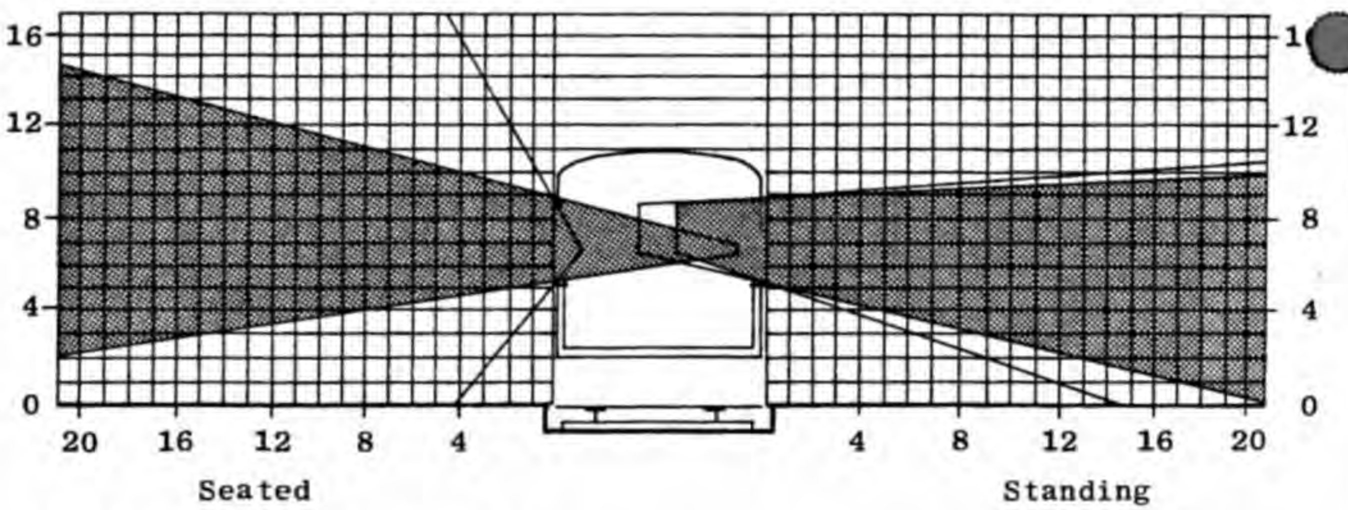
Clearances shown are for new facilities. Existing clearances, and absolute minimum clearances for special conditions must be obtained from the MBTA. Track and platform alignment and profile is determined by the engineers in conjunction with the Station Architects and the MBTA. For platform widths see Part IV Components. Structural dimensions shown are minimum unless otherwise noted.

REQUIRED CLEARANCES - Orange Line



ORANGE LINE · No.12 Car

Top of glass	9'-5 3/4"	above top of rail
Bottom of glass	6'-9 3/4"	above top of rail
Floor	3'-8 3/4"	above top of rail
Platform	3'-6"	above top of rail

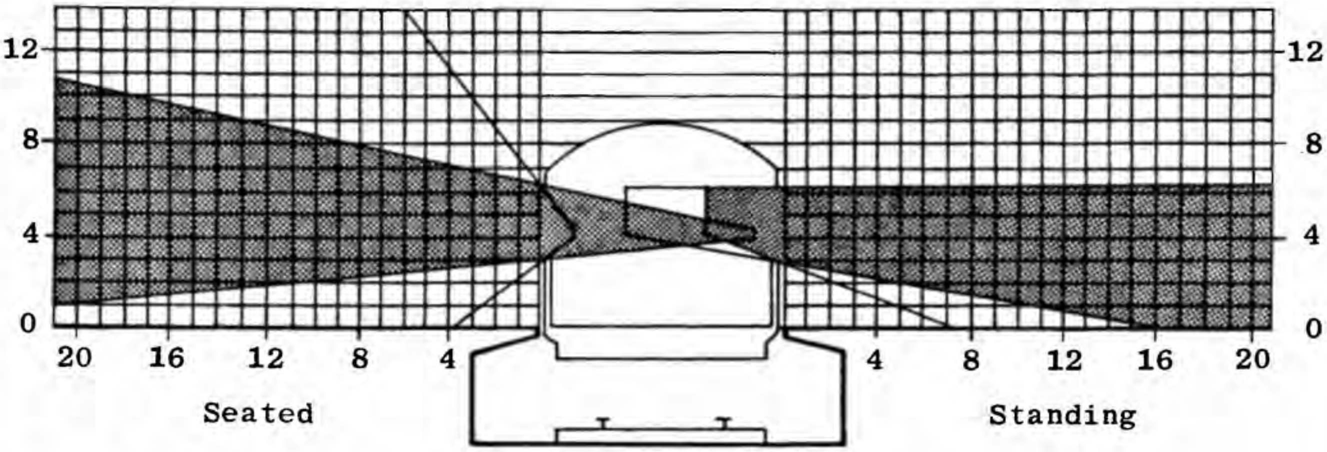


GREEN LINE · LRV

Top of glass	8'-10"	above top of rail
Bottom of glass	5'-7'	above top of rail
Floor	2'-10"	above top of rail
Platform	0"-3"	above top of rail

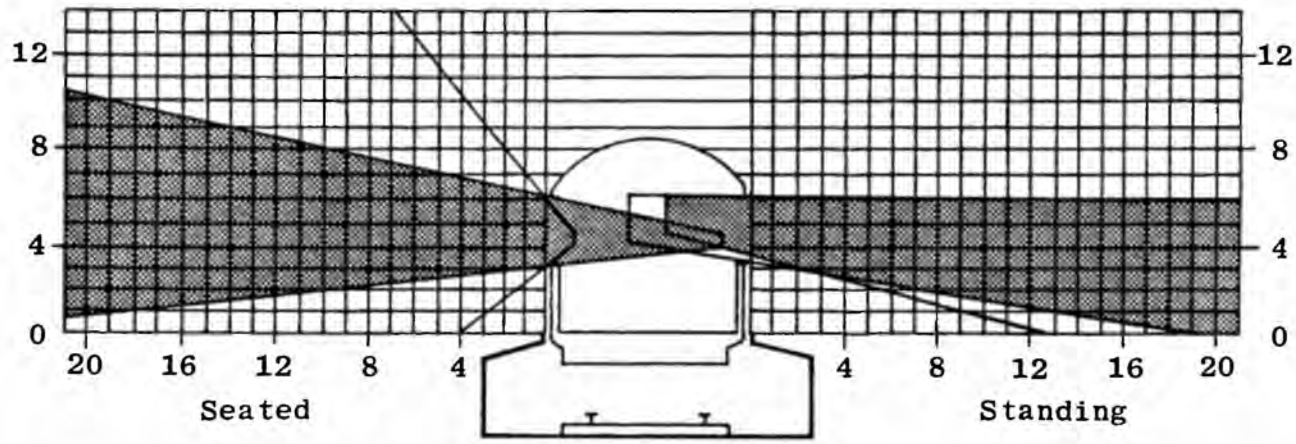
SIGHTLINES FROM CARS

Scale 1/8" = 1'-0"



RED LINE · No.1 South Shore Car

Top of glass	9'-9"	above top of rail
Bottom of glass	6'-10"	above top of rail
Floor	4'-1"	above top of rail
Platfrom	3'-11½"	above top of rail

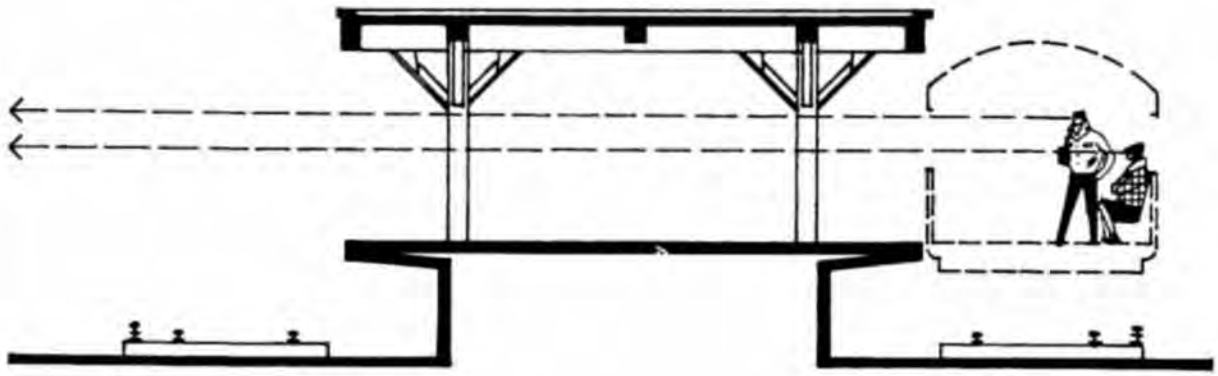


BLUE LINE · No.4 Car

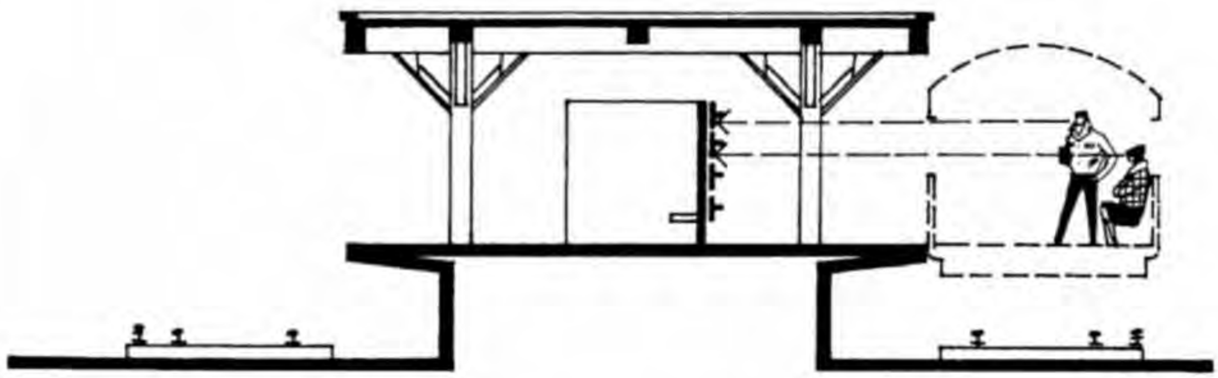
Top of glass	9'-2½"	above top of rail
Bottom of glass	6'-6½"	above top of rail
Floor	3'-5½"	above top of rail
Platform	3'-3"	above top of rail

SIGHTLINES FROM CARS

Scale: 1/8" = 1'-0"



Existing



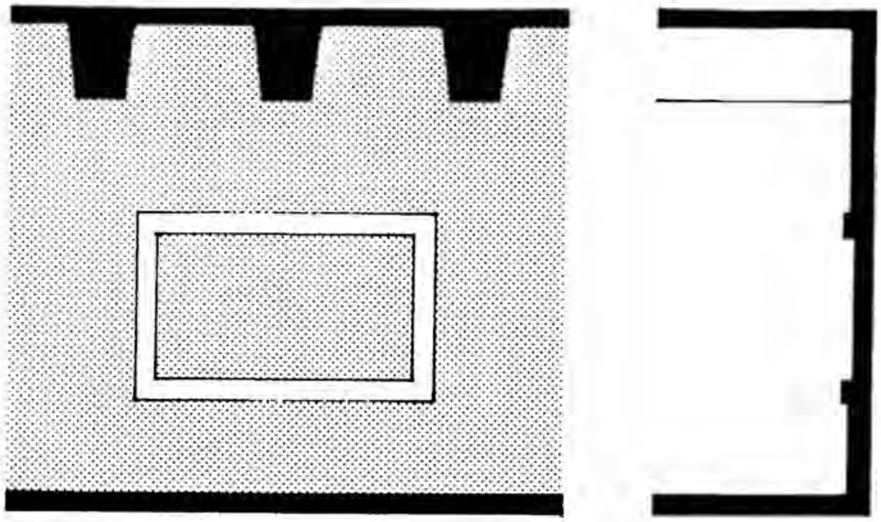
Proposed

Provide new walls on platforms for station identification and orientation graphics.

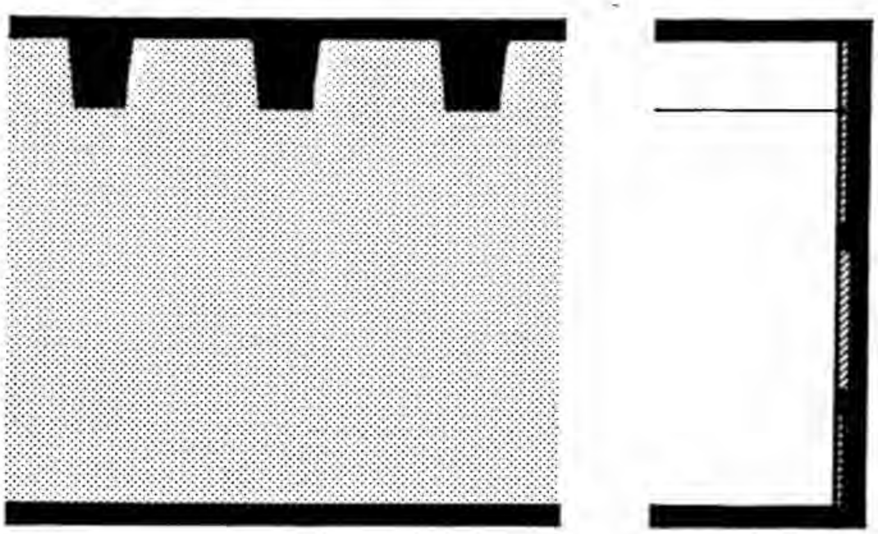
Example used: Savin Hill

NEW WALLS

Existing

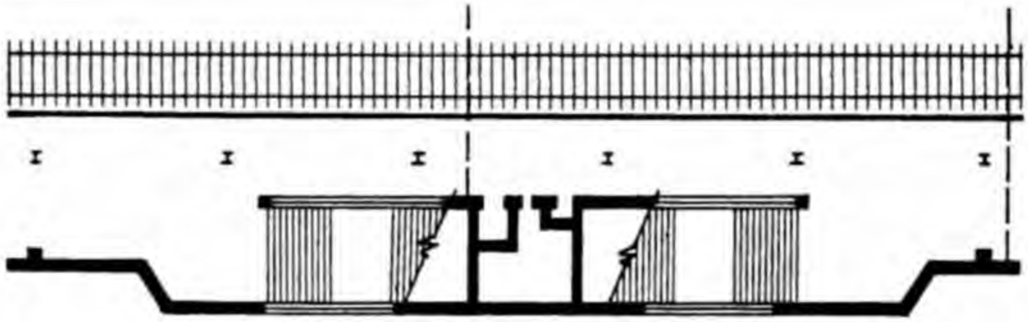


Proposed



Provide unbroken walls for identity bands, maps, orientation graphics, or benches, by eliminating advertising recesses and other miscellaneous changes of plane.

PLATFORM SIDE WALLS



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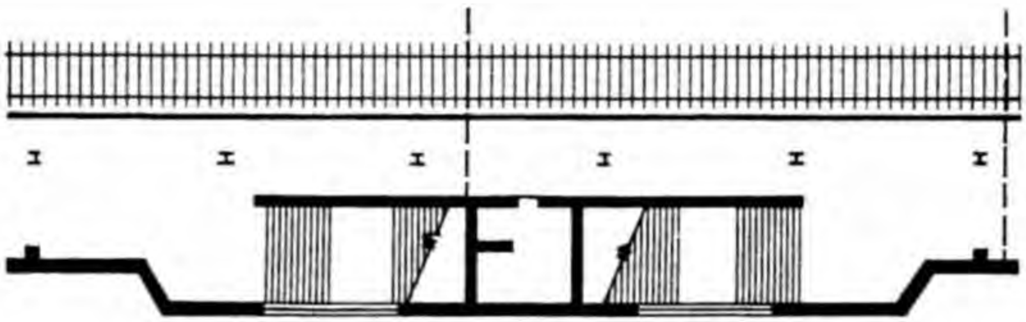
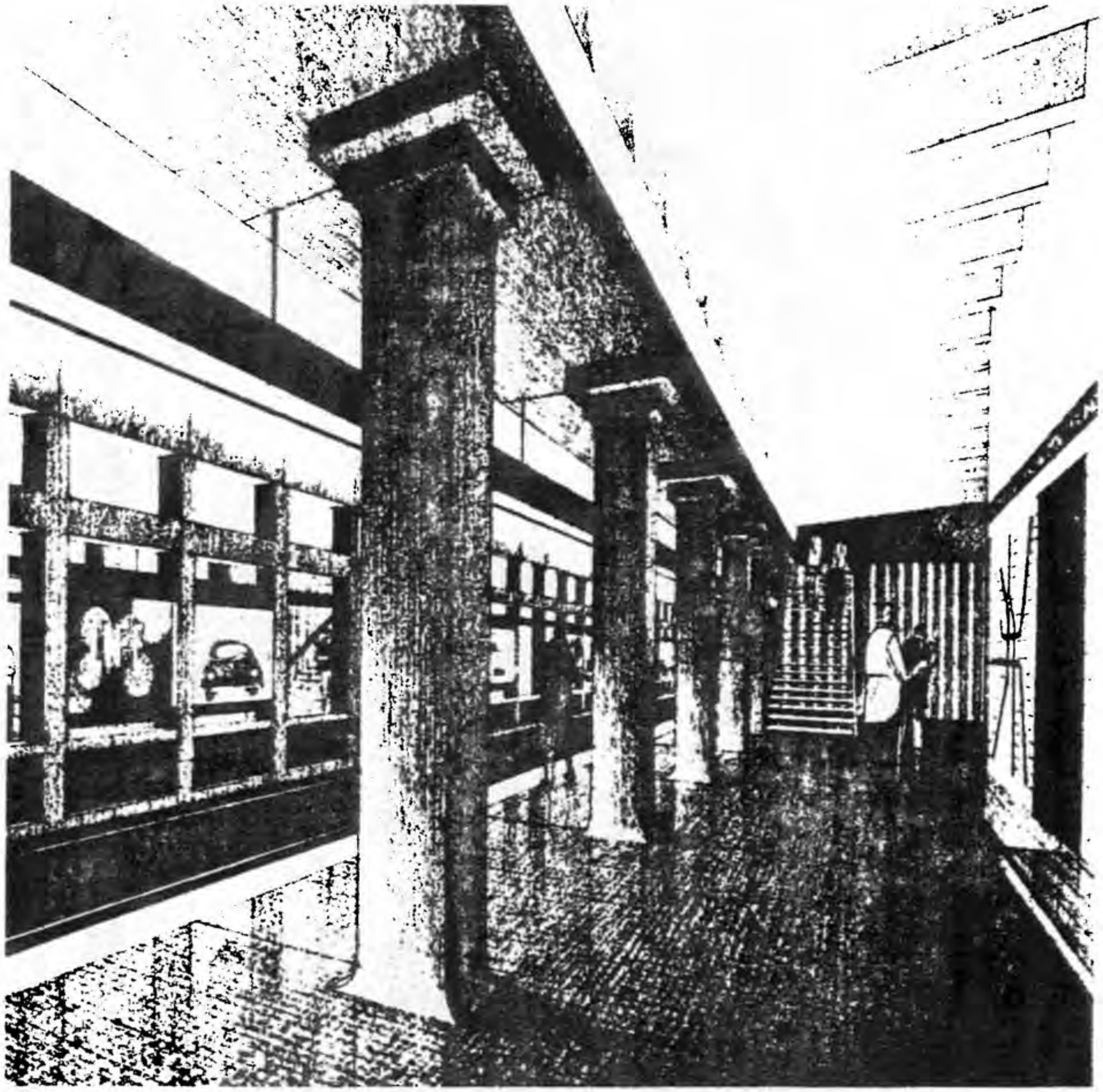


Proposed

Provide unbroken platform walls for identity bands, maps, orientation graphics, or benches, by eliminating unnecessary openings or niches. This also aids station maintenance.

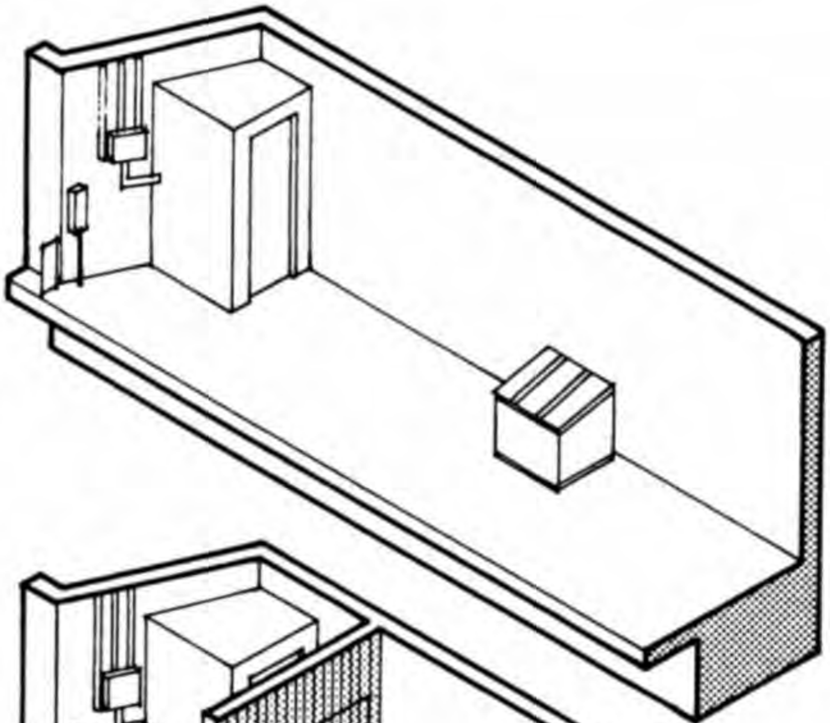
Example used: Beachmont

PLATFORM SIDE WALLS



Provide open view of end walls, with transparent stairs or other devices.

Example used: Arlington
PLATFORM END WALLS



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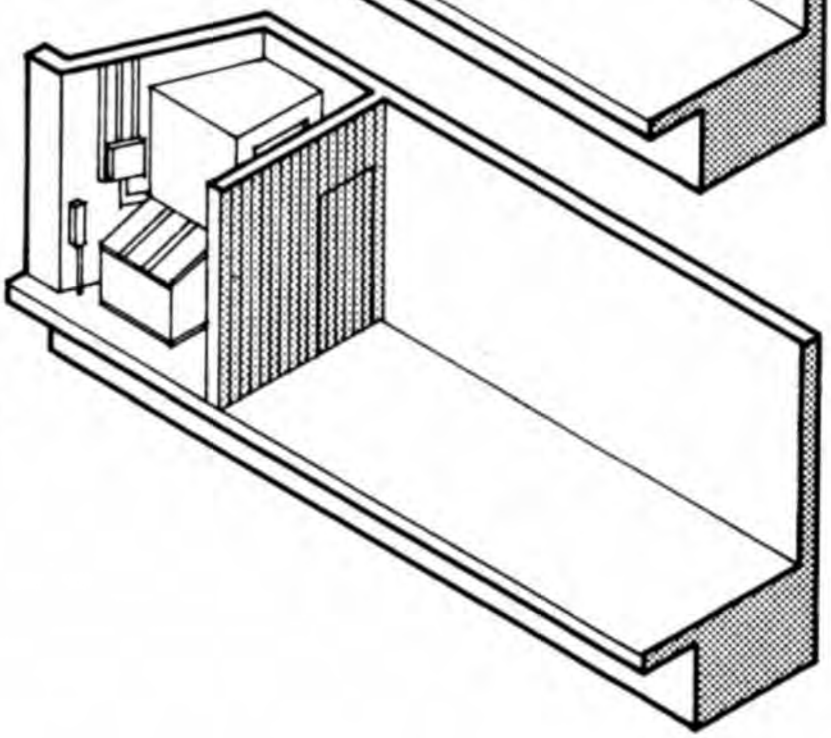
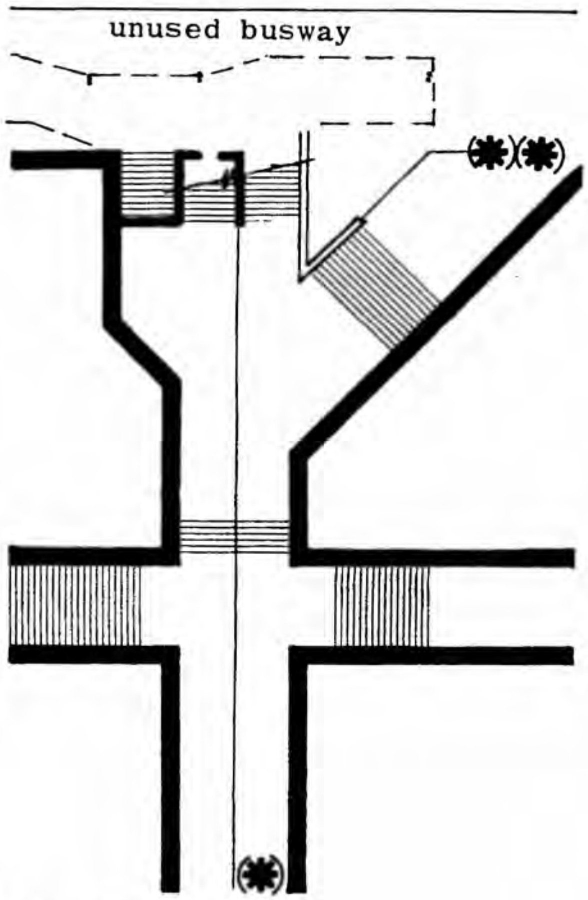


Proposed

Provide new end walls to define platform space and to mask-off unsightly utility elements.

PLATFORM END WALLS



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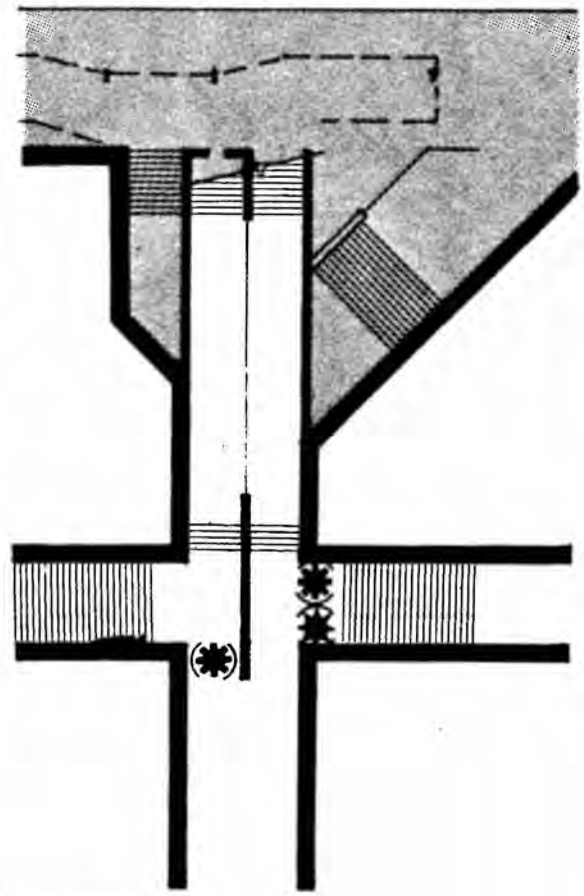
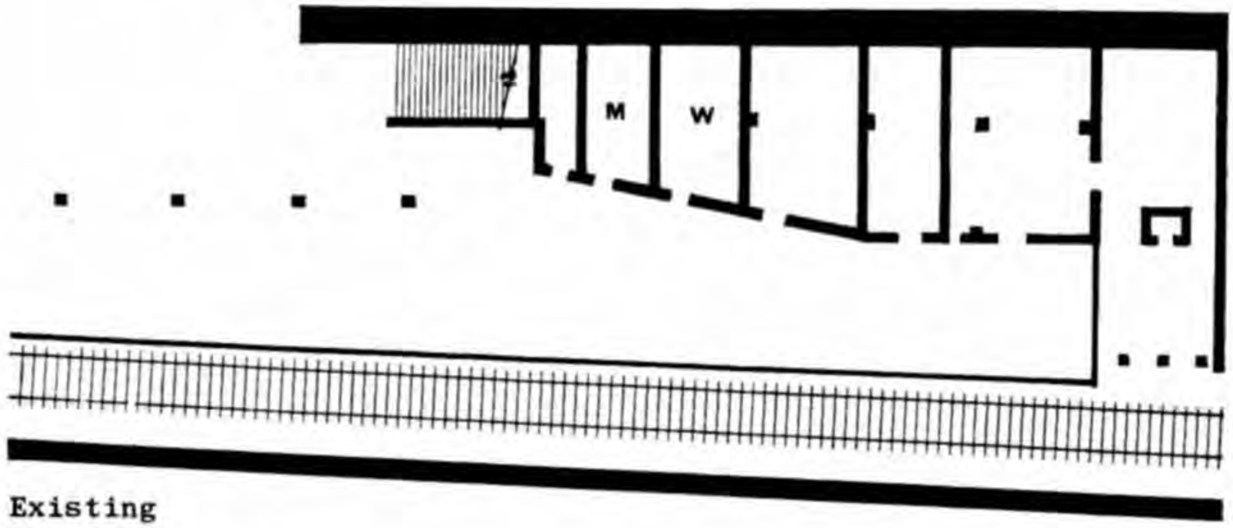


Proposed

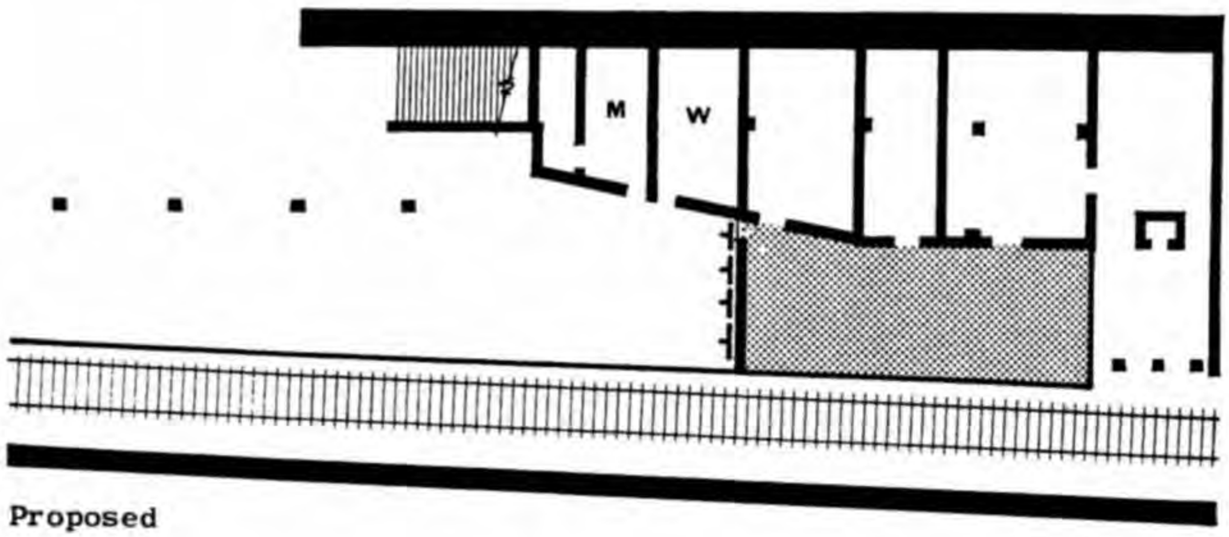
Simplify public spaces by closing-off areas and passageways no longer in use.

Example used: Field's Corner

UNUSED FACILITIES



Existing

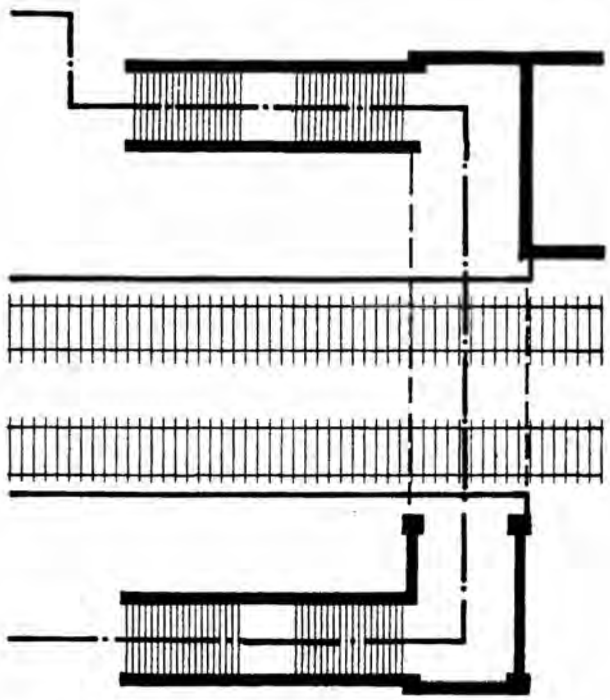


Proposed

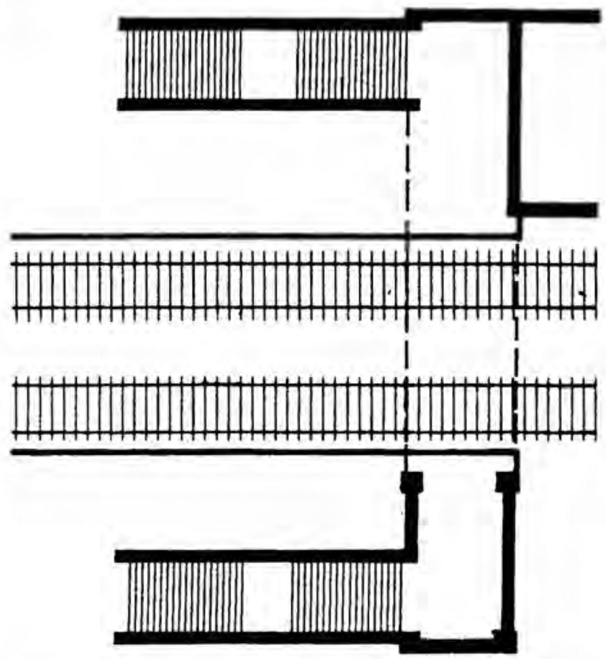
Close-off, with new walls, spaces not used by the public.

Example used: Maverick

NON-PUBLIC SPACE



Existing

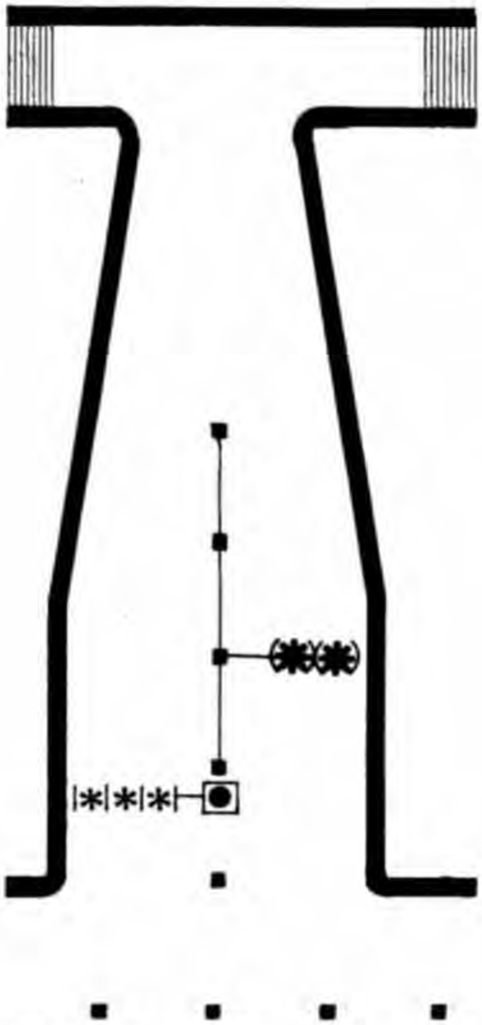


Proposed

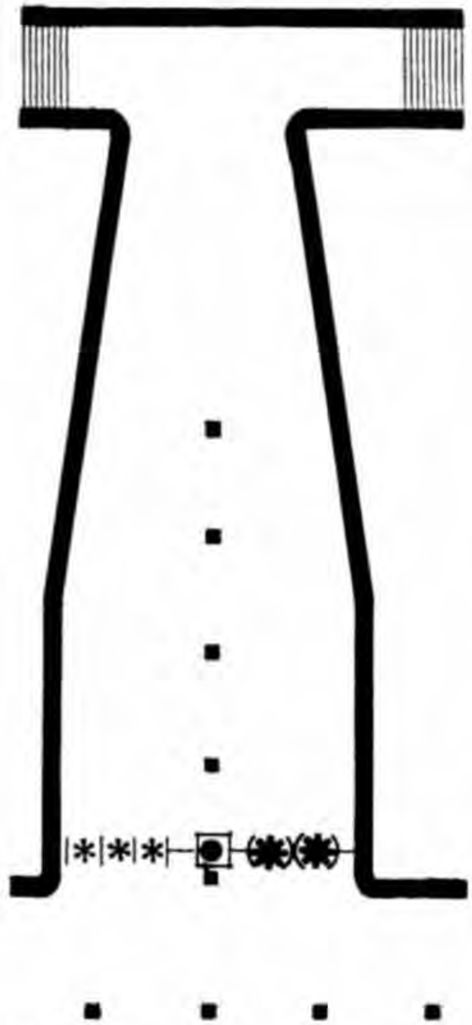
Eliminate unnecessary fences that have unpleasant visual and psychological effects. In this example, an unimportant option of circulation has been removed.

Example used: Orient Heights

UNNECESSARY BARRIERS



Existing

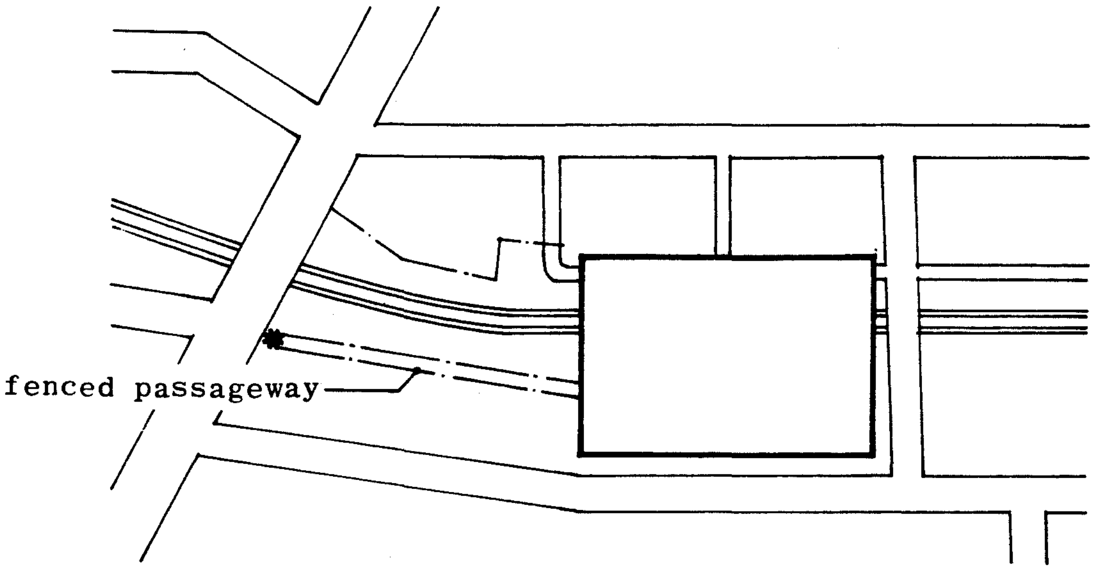


Proposed

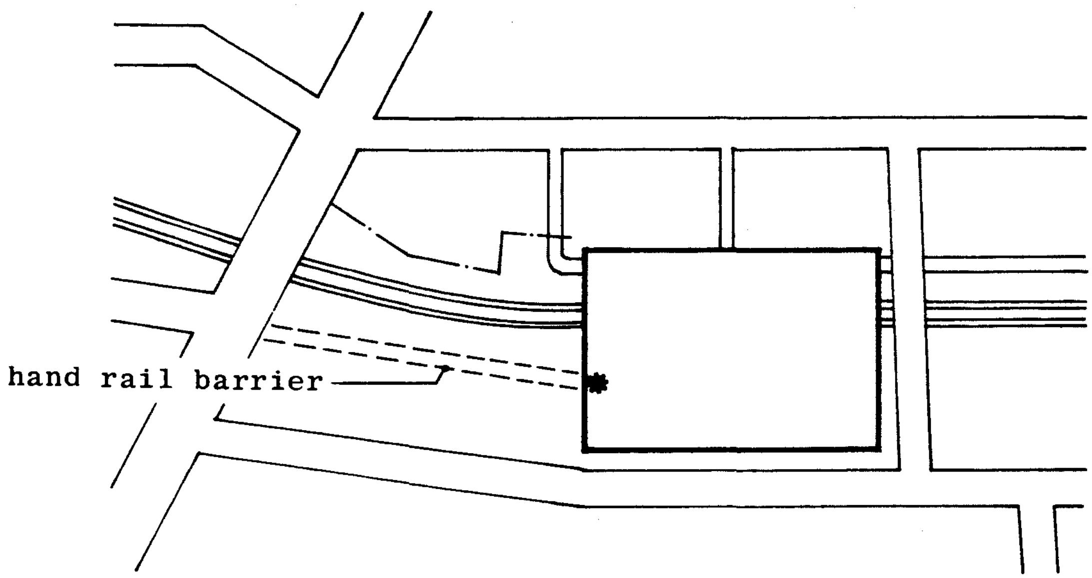
Simplify circulation spaces by eliminating and relocating barriers.

Example used: Copley

UNNECESSARY BARRIERS



Existing

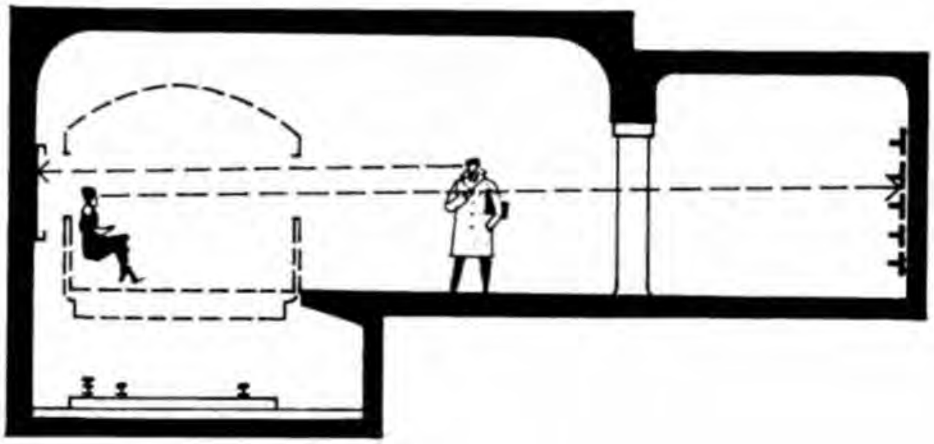


Proposed

Eliminate unnecessary barriers that have unpleasant visual and psychological effects. In this case relocation of the exit gate makes possible the replacement of a fenced passageway with a hand rail safety barrier.

Example used: Field's Corner

UNNECESSARY BARRIERS

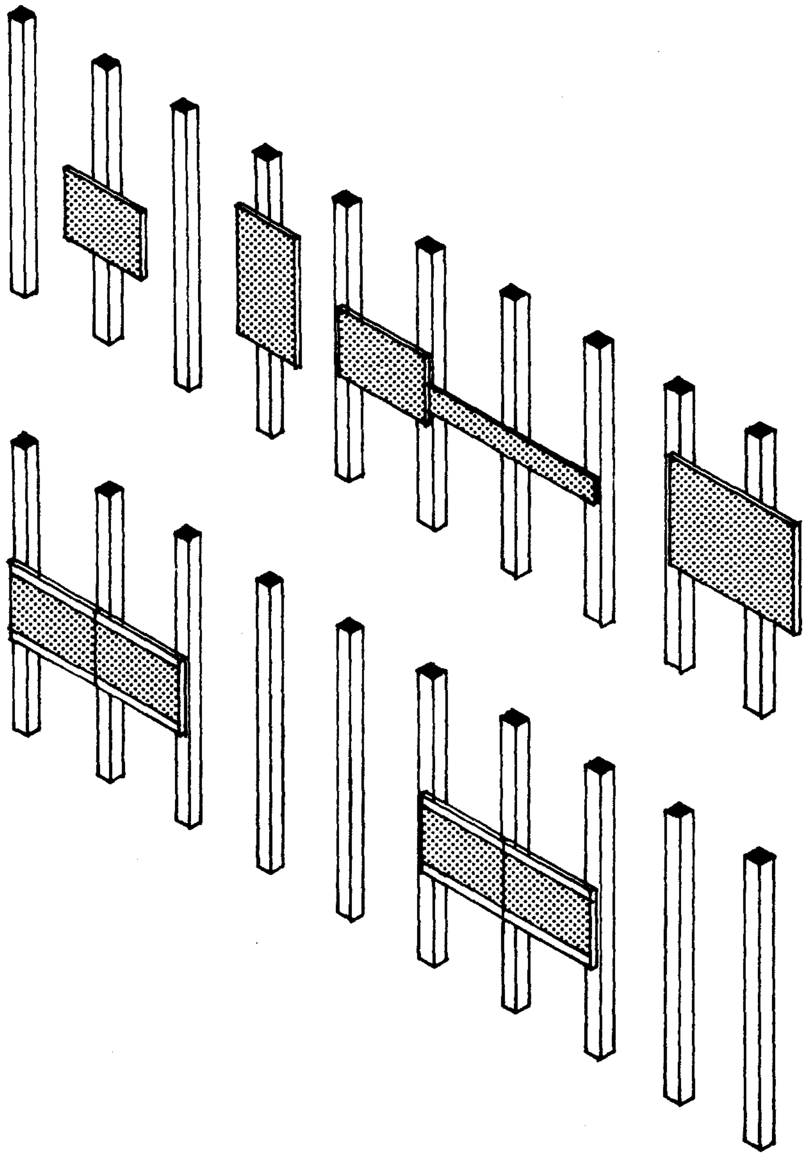


Segregate advertising from information graphics by locating advertising across from waiting areas and information graphics across from trains.

ADVERTISING AND INFORMATION

Existing

Proposed

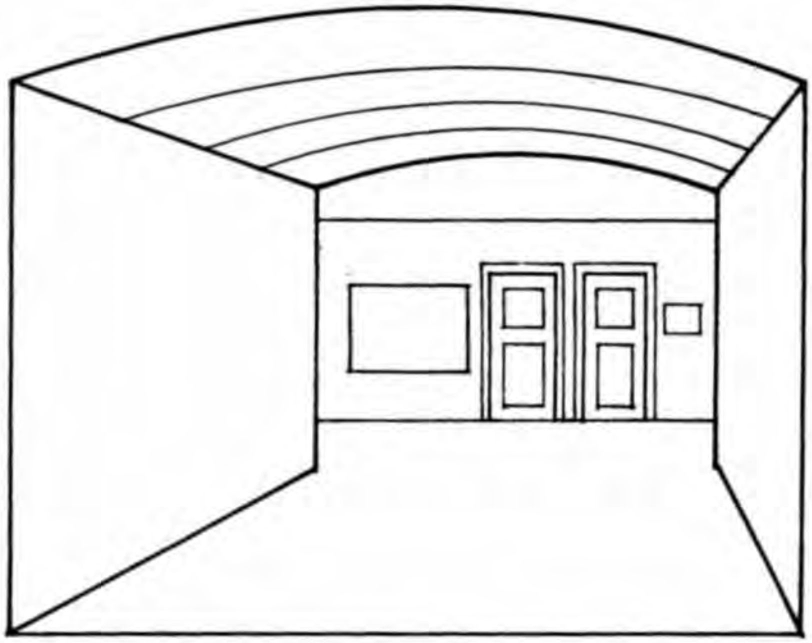


Relate advertising to structure, and in groups of units.

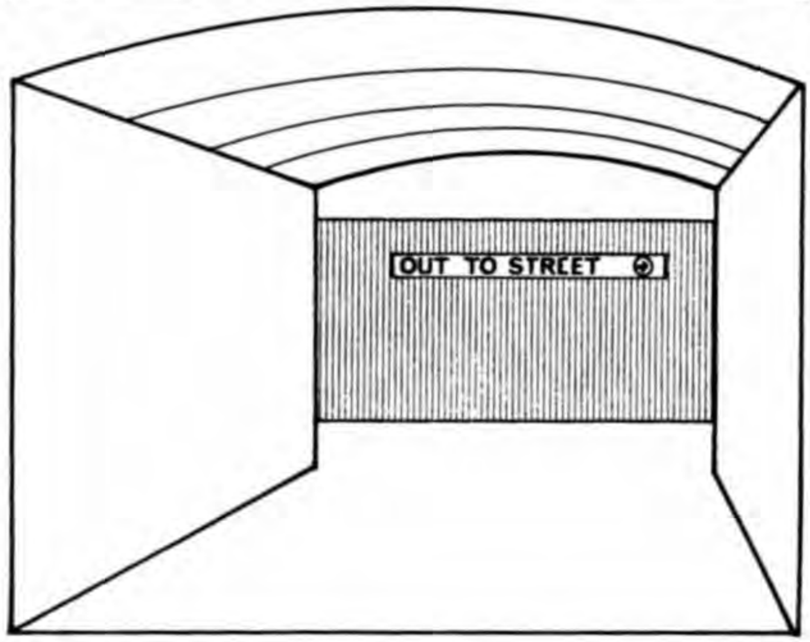
Refer to Part V: Graphics.

<u>ADVERTISING LOCATION</u>

Existing

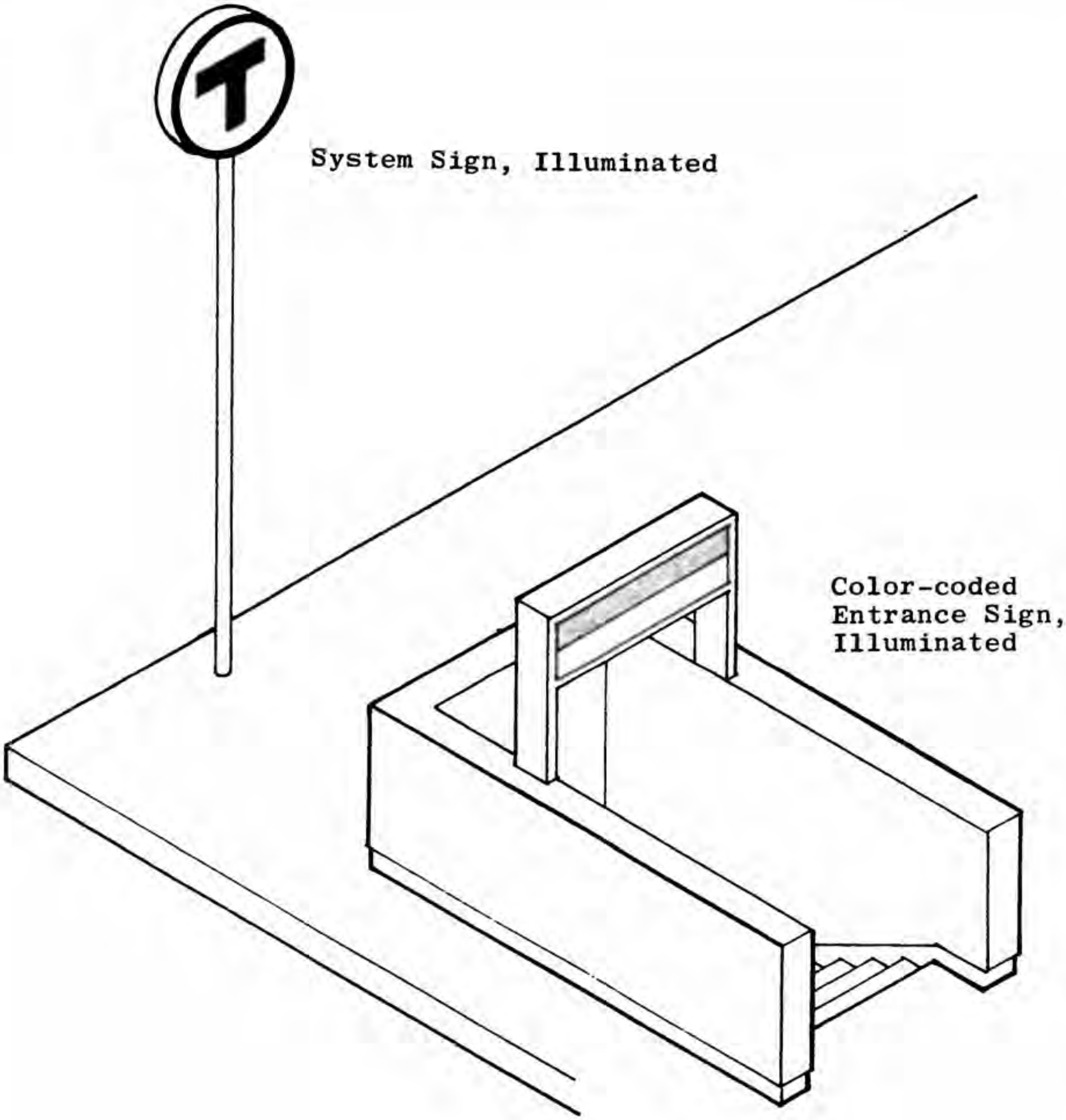


Proposed



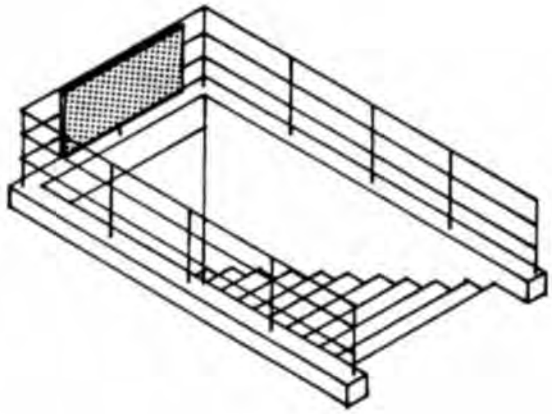
Walls at ends of passageways, opposite major entrances, or leading to exits, or opposite turnstiles, should be kept free of miscellaneous doors and advertisements so that they may be used for information graphics.

SIGN LOCATION

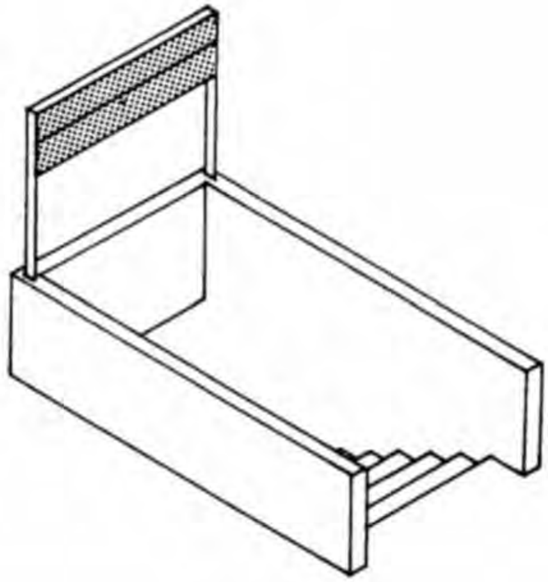


Provide illuminated signs at station entrances.
(See components and graphics sections.)

SIGN LOCATION



Existing

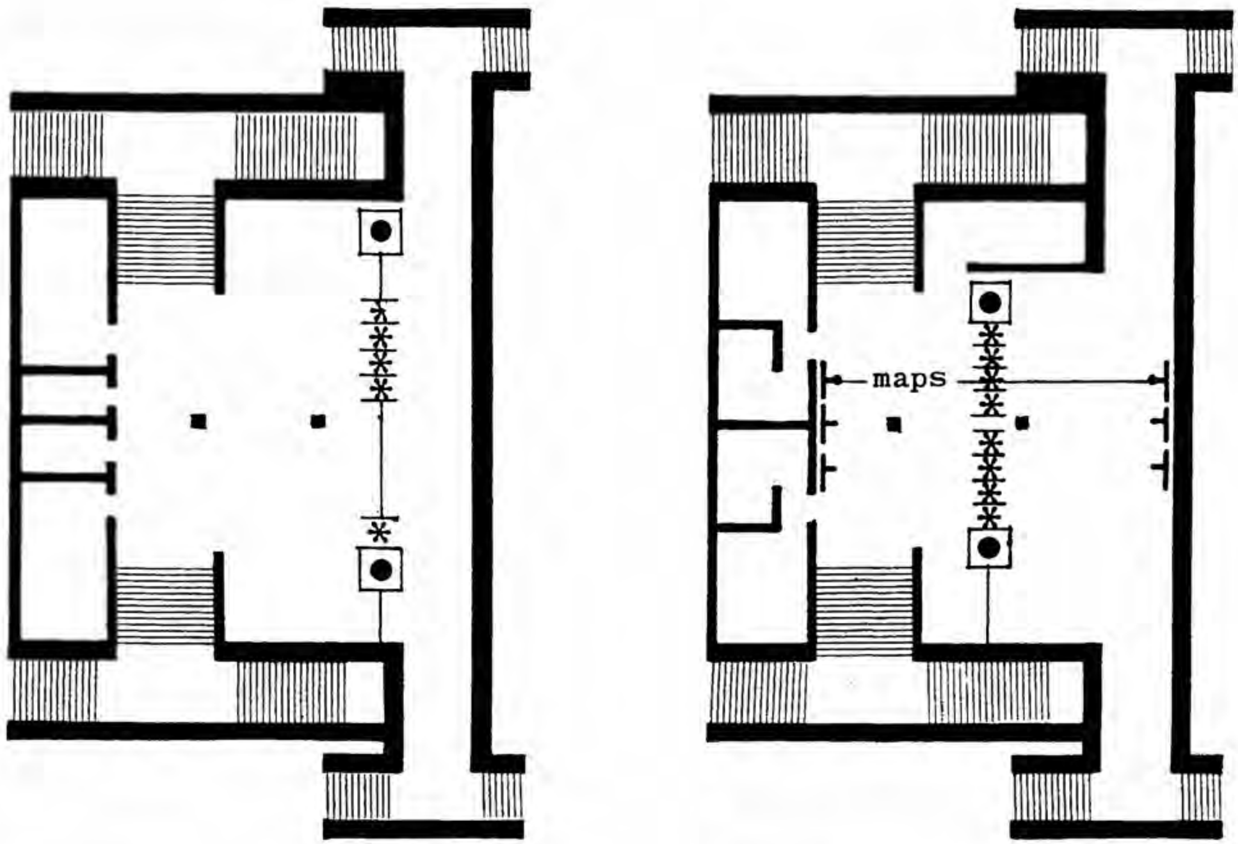


Proposed

Locate information signs at decision points for maximum visibility. In this example the sign has been raised above head height.

Example used: Government Center Over

SIGN LOCATION



Existing   Proposed

Provide map space immediately inside and outside of fare collection.

Example use: Prudential

MAP SPACE

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GUIDELINES AND STANDARDS
PART IV
COMPONENTS
REVISED 1977

MANUAL OF GUIDELINES AND STANDARDS

GENERAL INTRODUCTION

The Massachusetts Bay Transportation Authority has found it both necessary and possible to concentrate attention on the complex needs of people. Programs to improve service must now include a new emphasis on the quality of the transportation experience. In effect, transportation engineering has been joined by human engineering and environmental design.

This manual provides a framework for the continued coordination of all those elements in the system that affect human comfort.

Many of the criteria involved are common to all environments, such as the control of light, noise, humidity, temperature, wind, and odors, or the need for orderliness, through clear and easy circulation and clean appearance. Other criteria that are more specific to the transportation environment are such needs as safety, traffic handling capability, spatial variety, consistently available information, and orientation.

The most important single criterion that has guided the preparation of this manual is the need for orientation. The rider must not only be physically comfortable, he must also know in the fullest sense where he is and where he is going.

Since to the layman a public transportation system is to a large extent an invisible skeleton of the city and metropolitan region, the comprehension of that structure generates an awareness and appreciation of the city itself, and an appreciation of travel through it.

There are many aspects to achieving this orientation. Circulation at all points must be direct and open. Spaces should relate visually to their surrounding environment, either through direct openings to adjacent spaces and structures, or in the case of platforms, by graphic reflection through photographic murals.

Above all, the need for orientation places great emphasis on maps and a consistent system of identification and directional signing. Graphics then emerges as a major factor in the design of each environment, a factor that must be given high priority in the early design phases of each project.

It is hoped that all participants in all programs will familiarize themselves with the entire manual, so that the implications of each decision can be understood in a system-wide context.

The standards and guidelines presented here are not inflexible rules. They are a framework for meaningful development and variety, and offer no restriction to the capacity of each participant to evolve better solutions to old or new problems.

As new solutions are developed and approved, revised and additional pages for the manual will be issued to all participants.

Part IV of the Manual illustrates a number of elements and conditions which occur repeatedly throughout the System. It establishes recommended treatments for these conditions, gives layout information for required station equipment, and describes the specially designed components that have been adopted as Authority standard. The intent is that similar situations in different stations receive similar treatment, with resulting advantages in large volume purchasing, increased clarity for subway users, and an intensified sense of unity among the variety of station types.

Refer to Part V: Graphics, and Part VI: Lighting, for other standardized elements.

INTRODUCTION

PART IV COMPONENTS

E. Safety - Emergency - Control

General Description

These structures provide access to below grade platforms and may also function as exits. They are important street elements and careful consideration should be given to their relationship to other street furnishings and to the character of the street as a whole. In order to insure a consistency from station to station, they should be the types described in this Section.

Special situations: A different type may be approved by the Authority and their consultants.

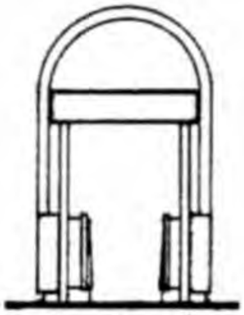
Definitions

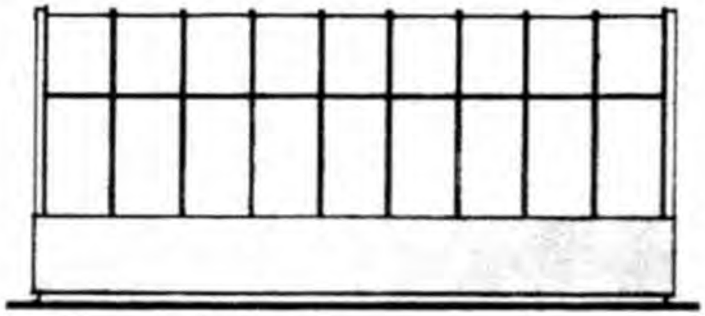
Entrance - a surface structure without roof, simply serving as entrance or exit for fare collection facilities below. Station close-off occurs below the surface.

Headhouse - a surface structure serving the same function as an entrance, but with a roof and surface level close-off. Escalator installations require headhouses.

Control House - a larger headhouse, housing a fare collection line and, sometimes, service facilities and concessions.

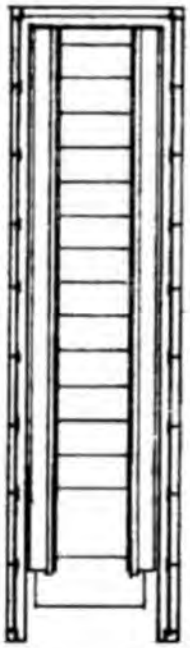
EXPLANATION

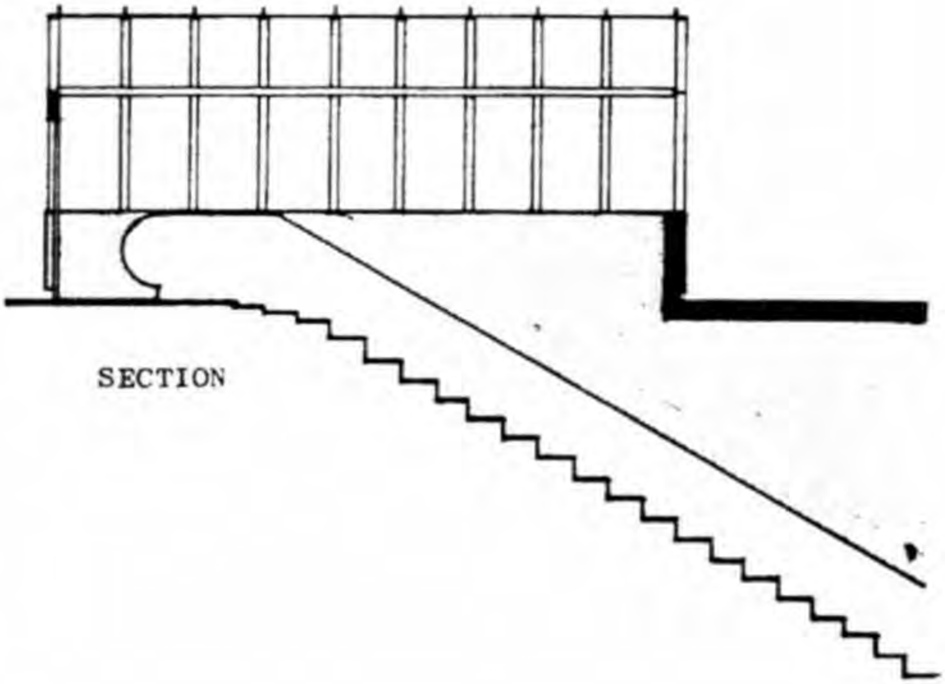




6'-0" minimum for escalator
8'-0" maximum for stairs, no center handrail

FRONT ELEV SIDE ELEV





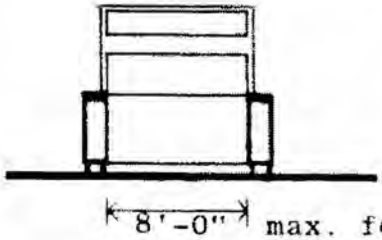
SECTION

PLAN

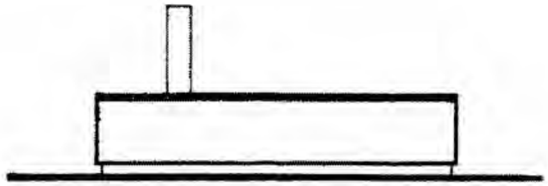
The Type 1 steel and glass structure permits maximum visibility of the surrounding area and also permits maximum light penetration to the lower level, while providing complete weather protection.

This type has been installed at Central Square

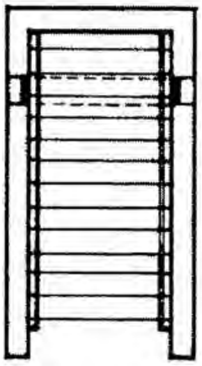
GLASS VAULTED TYPE 1 HEADHOUSE scale 1/8" = 1'-0"



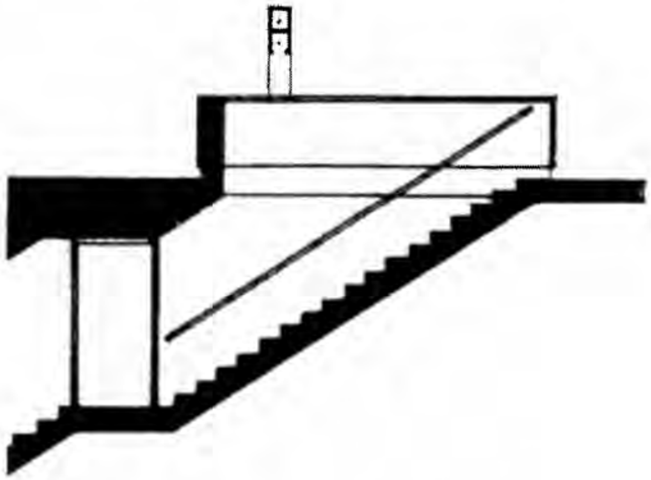
FRONT ELEVATION



SIDE ELEVATION



PLAN

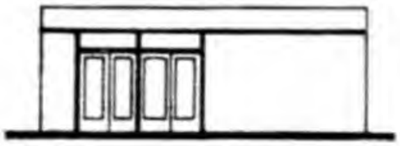


SECTION

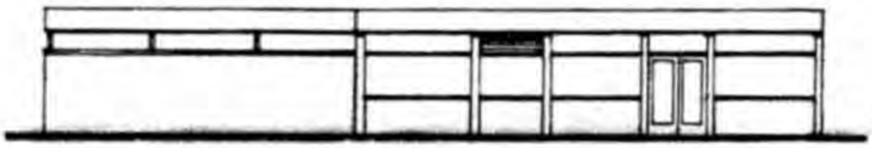
The Type 2 structure provides access to stations by means of a minimal surface structure. It should be used where the vaulted type would result in a physical or visual interference with surrounding elements.

Type 2 is normally used only with stairs, since escalators require overhead protection and surface level close-off. Parapet walls must be high enough to make sitting difficult.

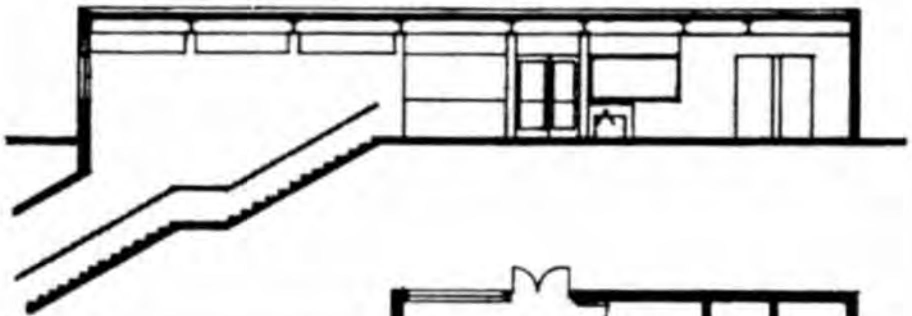
<u>LOW WALLED TYPE 2</u> scale 1/8" = 1'-0"



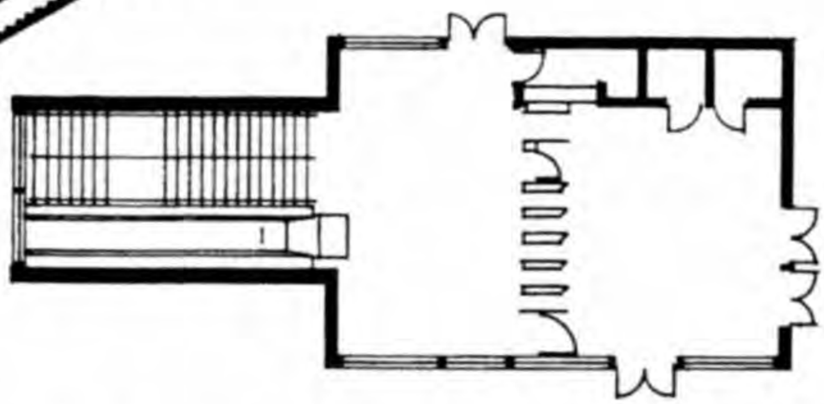
FRONT ELEVATION



SIDE ELEVATION



SECTION

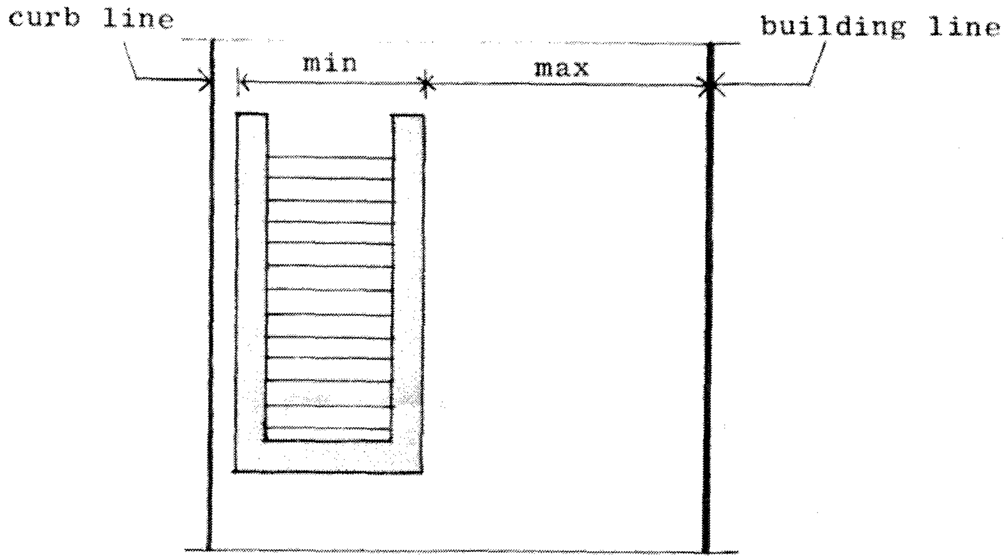


PLAN

The Control House Type differs from the purely entrance and exit surface structures by the inclusion of a fare collection area. The dimensional recommendations contained in the section on fare collection apply.

This type is used in the design for North Station.

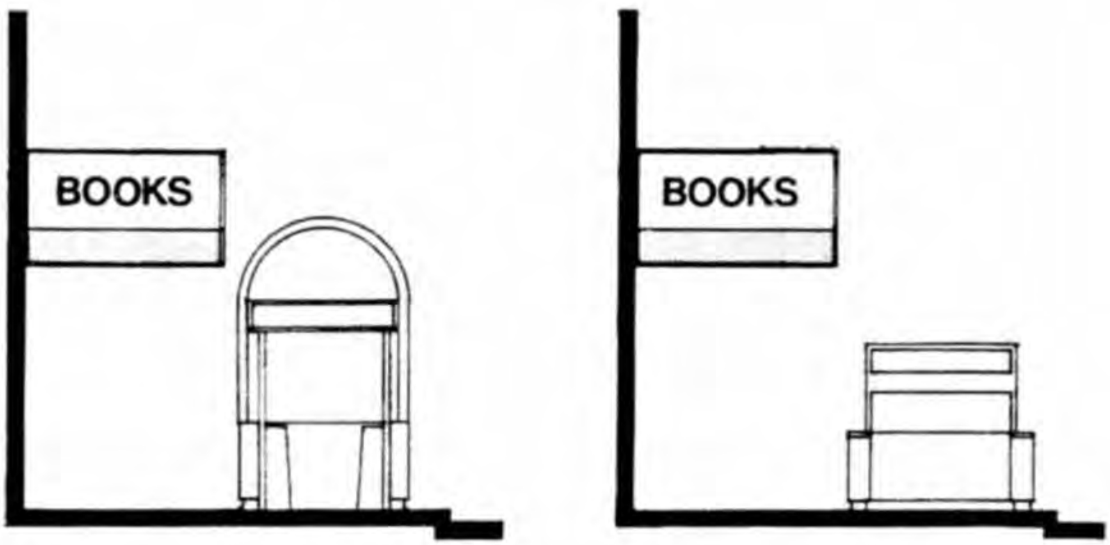
CONTROL HOUSE TYPE 3



The following factors will control the choice of type and/or the dimensions of a surface structure.

Width of Sidewalk In situations with narrow sidewalks the minimum width of the surface structure should be selected so that sidewalk circulation will be least restricted. Approval of local traffic authorities is required.

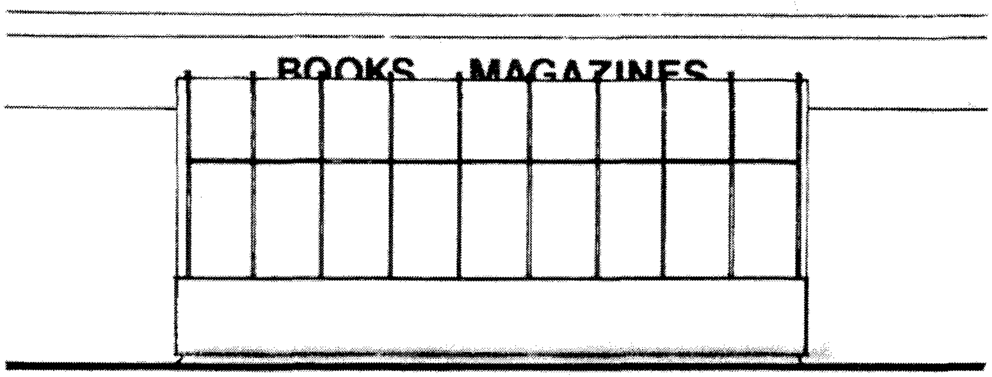
CONTROLLING FACTORS scale 1/8" = 1'-0"



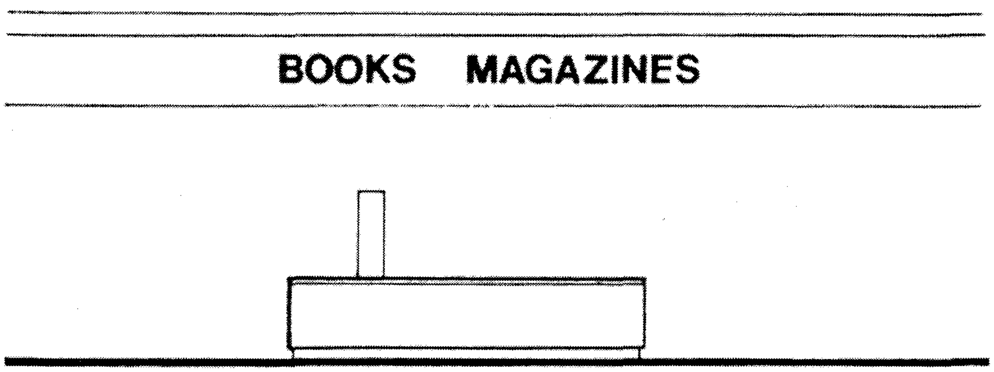
Perferred

Building projections - existing signs, lights, and similar elements should be considered when selecting the surface structure. Close proximity or actual contact of MBTA structures with nearby elements should be avoided.

CONTROLLING FACTORS   scale 1/8" = 1'-0"



ELEVATION



ELEVATION - Preferred

Visual Sight Lines - It is important that visual conflict between MBTA structures and surrounding signs and buildings be avoided. The architect should make the necessary field investigations to insure that no conflicts will exist the selected surface structure.

CONTROLLING FACTORS scale 1/8" = 1'-0"

The following situations apply only at certain stations. Proposed designs will require special review and approval by the Director, and often by local authorities.

Entrance Through Buildings

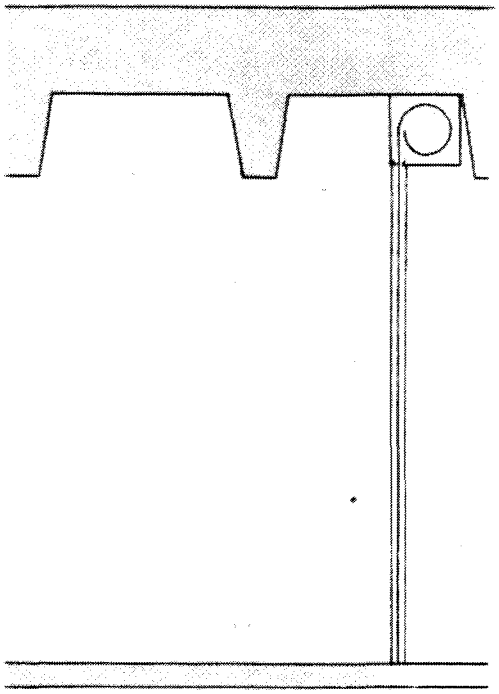
In many cases access to stations will be through existing or new structures. In this event the design will be largely determined by existing conditions.

Historical Area

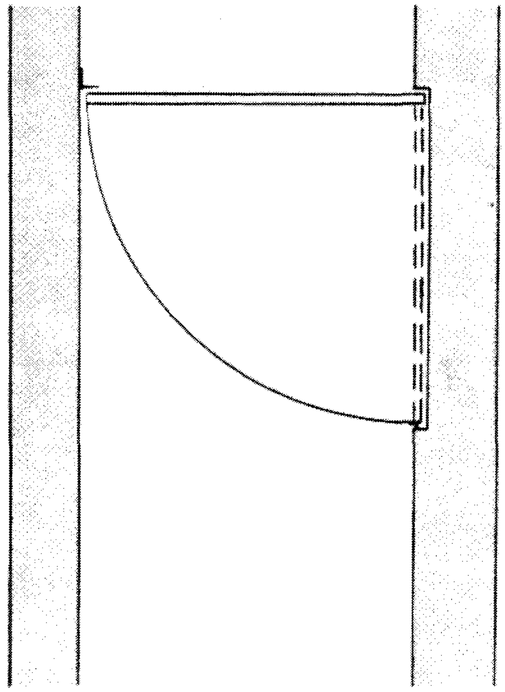
Occasionally surface structures are located in areas of historical importance. In such cases the character and materials of the surrounding area will determine the design approach.

Multiple Use Structures

The design of surface structures for multiple use is desirable, provided that space is available, that the other use is suitable to a subway entrance, and that the identity of the MBTA elements is in no way compromised. Multiple use provides an active relationship between street and station, draws the public into the System, and furnishes full or part-time supervision by the concessionaire's personnel.



Overhead Door
preferred



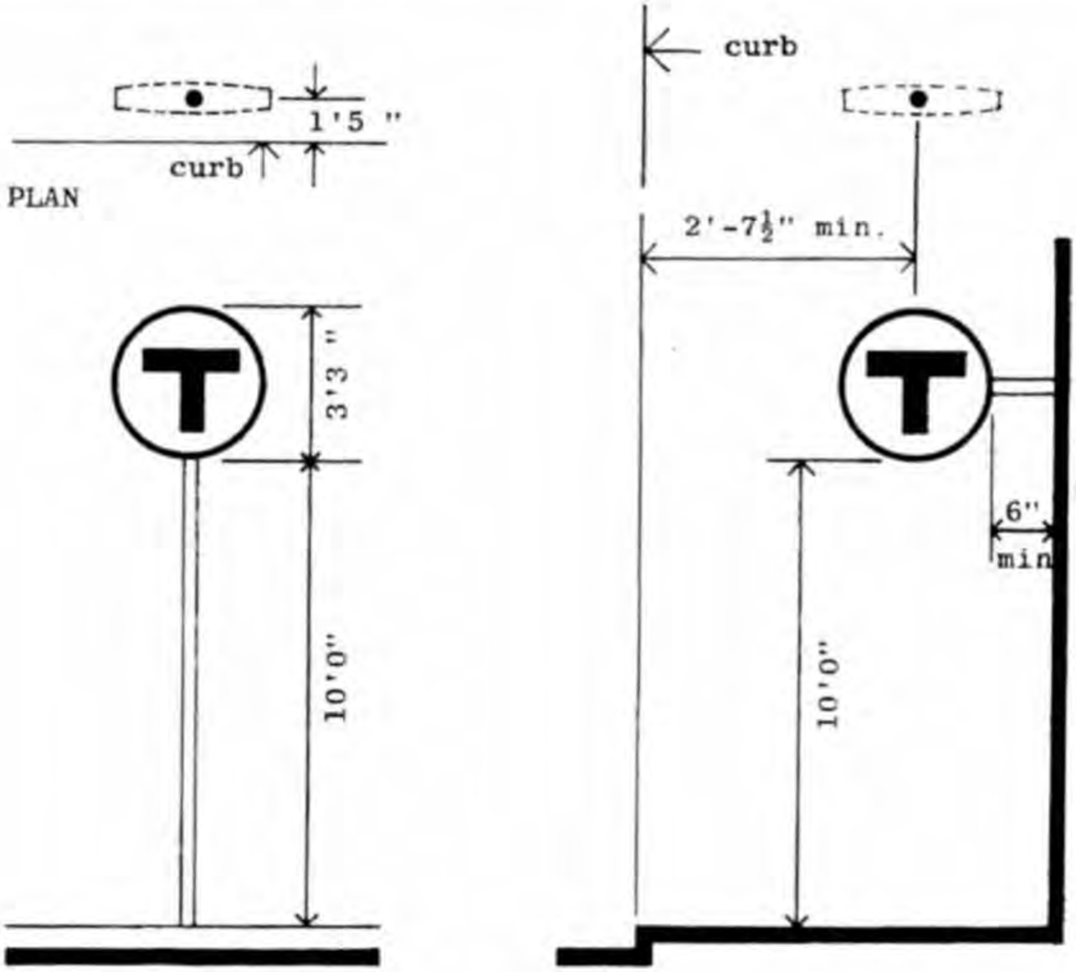
Swing Gate

All surface structures are closed off during non-operating hours. Existing closures vary, being, typically: hollow metal swing doors or roll-down overhead doors at street level for headhouses and control houses, and steel plate swing doors at the bottom of stairs for entrances.

In many cases, it will be possible to refurbish the existing closure. Otherwise the preferred closure is a roll down grille, and where overhead clearance is insufficient, a swing gate. Gates and grilles should be open to passage of air. In the open position the closure should be recessed, if possible, to minimize obstruction to traffic.

Pantograph gates have been found too insubstantial for use as closures. Closures should have locks capable of operation from either side.

STATION CLOSURES



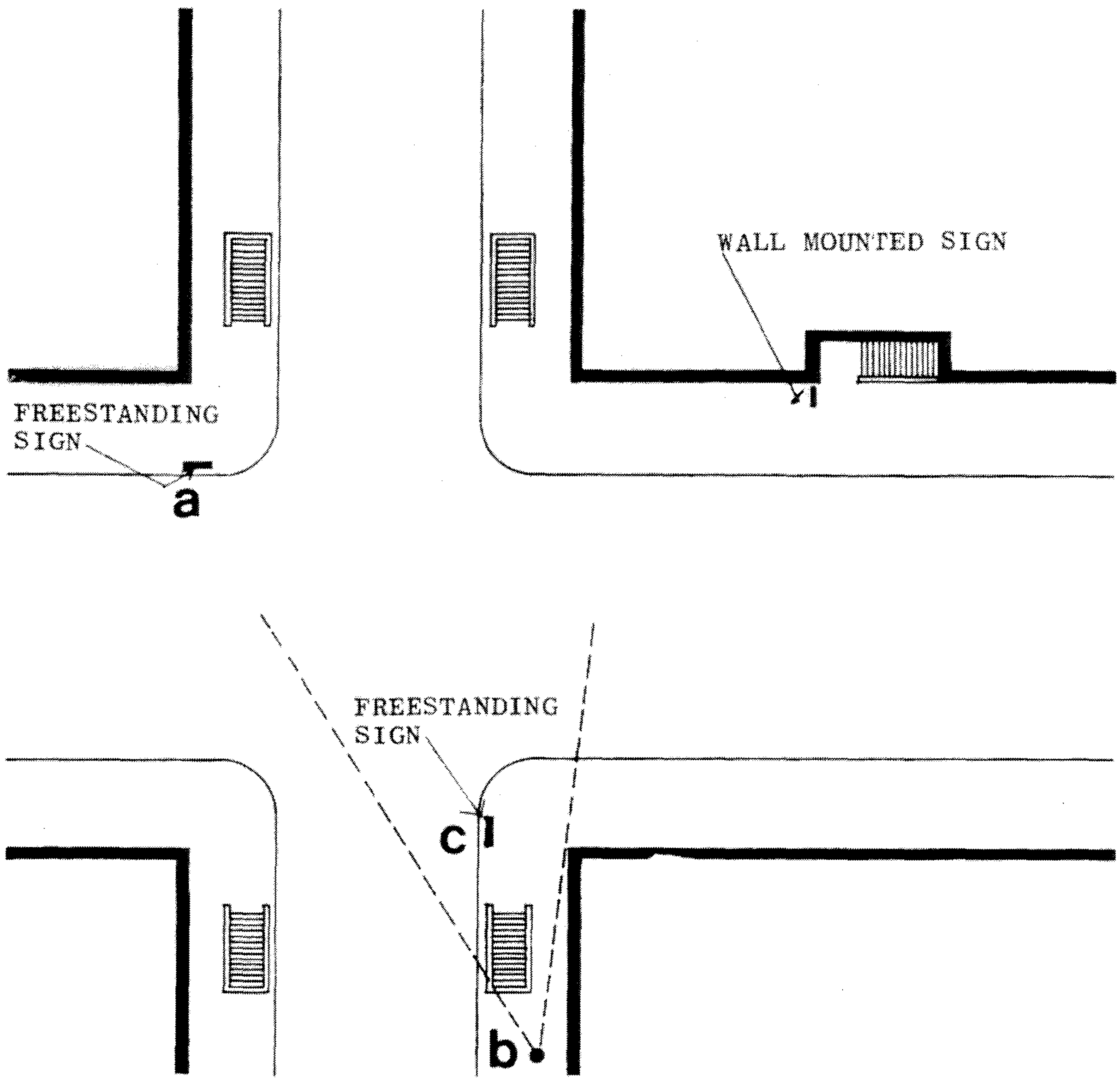
T Sign Description

An internally-illuminated T sign should be located at all surface entrance structures. It may be freestanding on the sidewalk provided it adheres to the clearances and mounting controls above. Where a freestanding sign is impractical for physical or visual reasons the sign may be wall-mounted.

The sign is double-sided. Each face is 3'3" in diameter and formed of white translucent plastic with a black T and circle on the surface. If it is freestanding it should be mounted 13'3" high from the ground plane to the top of the circle. The wall mounted sign should be mounted at the same height wherever posible.

The sign is a standard component with no variation permitted.

IDENTIFICATION SIGNS



T Sign Location Requirements

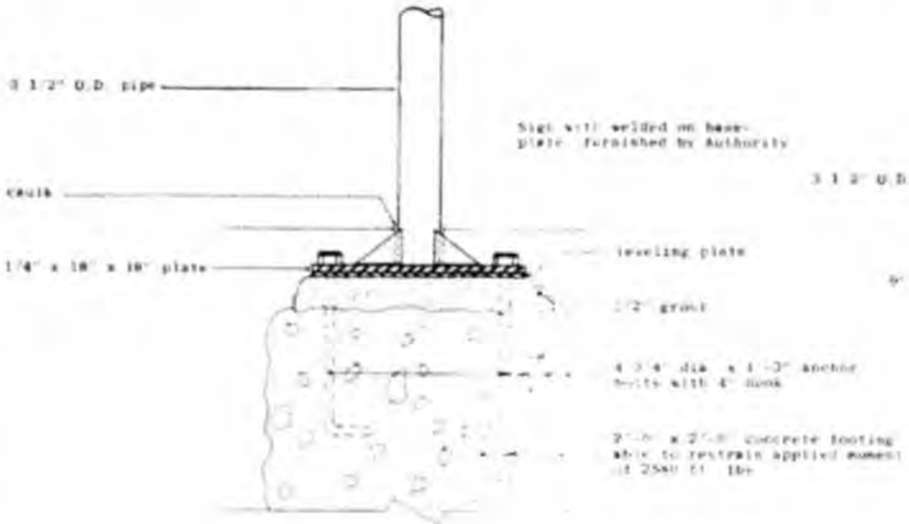
a. Parallel to curb - Allows sign support to be close to curb and still have vehicle clearance 1'-0" from curb edge.

b. Signs should be located so that they are visible from the sidewalk and not obstructed by building or projections.

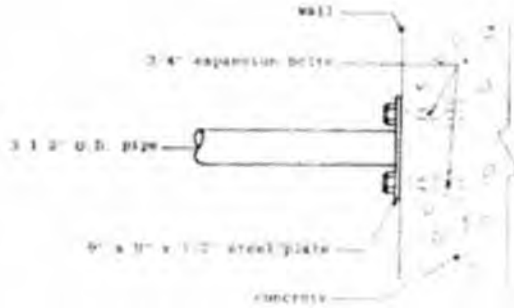
c. Signs at the different entrances of an intersection should be oriented perpendicular to each other to be visible from both major directions

IDENTIFICATION SIGNS

"T" SIGN ANCHOR DETAIL



"T" SIGN WALL MOUNT DETAIL



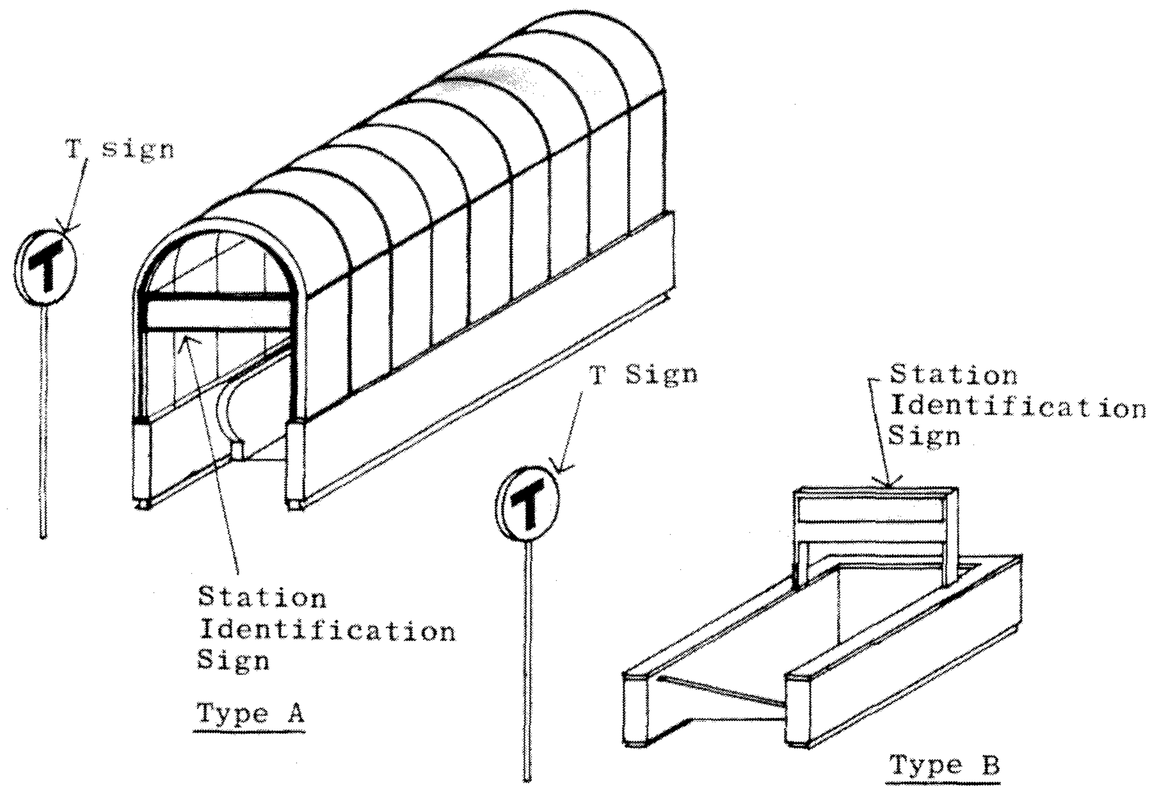
ELECTRICAL SERVICE

2 - #12 wires
60 cycle - 110 volts - a.c.
Conduit to be installed in one run between junction box in sign face and nearest pullbox. No pullbox at base of sign.

Means of current supply is the responsibility of the installing contractor.

Detailed drawings are available from the Authority.

IDENTIFICATION SIGNS

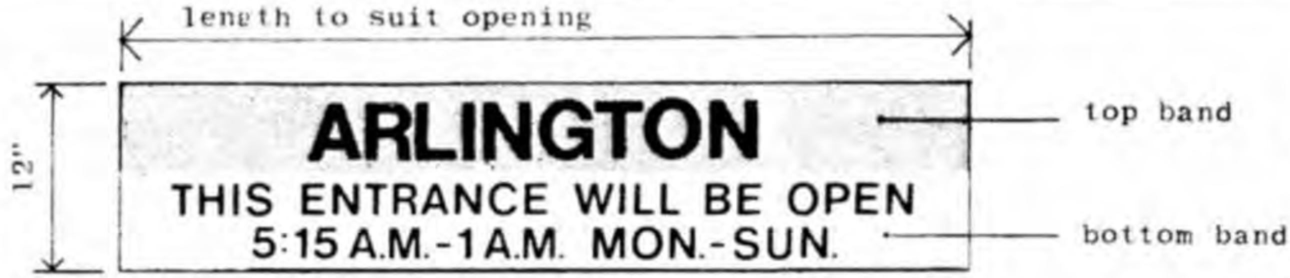


Station Identification Signs

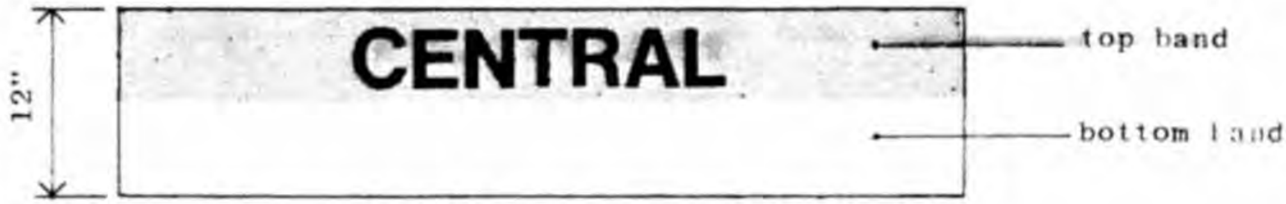
Internally-illuminated signs are to be used to identify the various stations and are located on both surface entrance and exit structures. The type of sign depends on the type of entrance structure. The type B sign also incorporates stair lighting.

Approval by traffic authorities is necessary for T sign location.

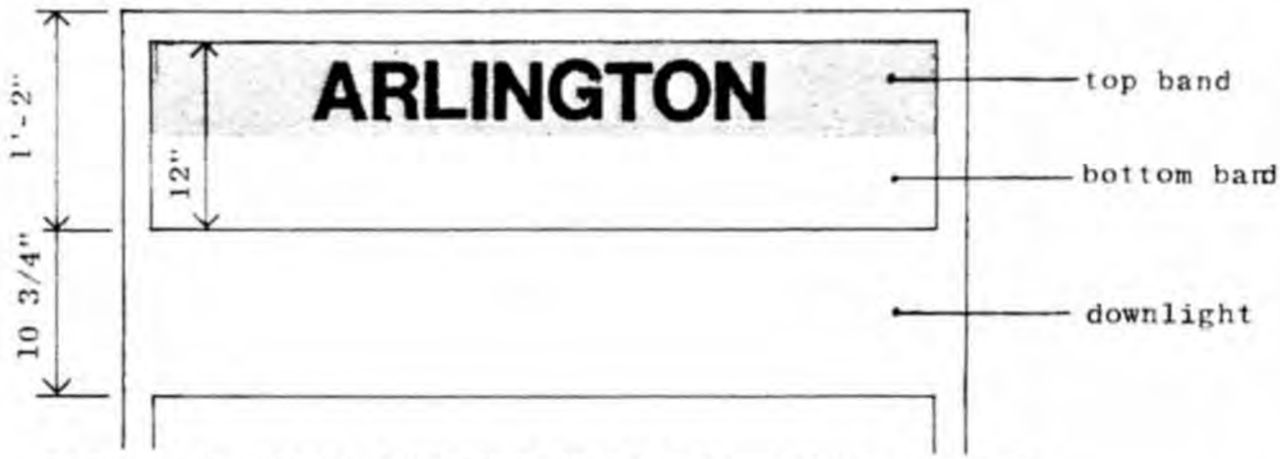
IDENTIFICATION SIGNS



BACK ILLUMINATED STATION SIGN (TYPE A or B)



OPAQUE STATION SIGNS (TYPE A or B)



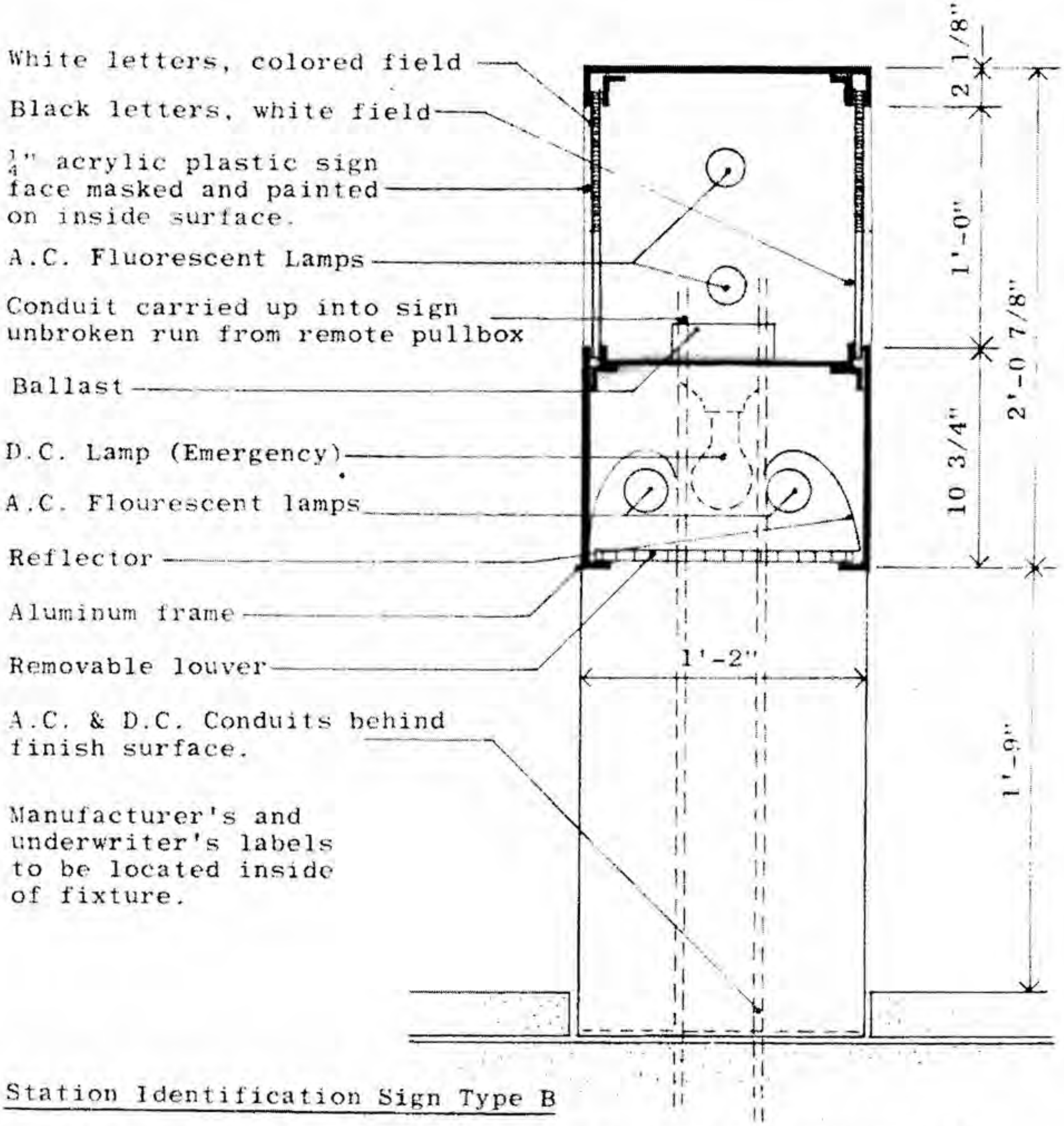
BACK ILLUMINATED STATION SIGN WITH DOWNLIGHT (TYPE B)

Station Identification Signs

Top band has background code color of the Line with station names in white letters.
Bottom band has white background with entrance information in black letters. The width of the sign varies with the entrance structures. The information provided on the lower band varies with the station.

For colors and lettering see Part V, Graphics.
Bottom band text will be furnished by the MBTA Planning Dept.

IDENTIFICATION SIGNS



Station Identification Sign Type B

Sign interior is schematic. In dimensions and appearance, this sign lighting fixture is a standard component with no variations permitted.

Fluorescent: 800 ma, full width of sign
Incandescent (emergency, D.C.): 2 - 151 watt, 600 volts, wired 5-in-series.

Identification Sign scale 1½" = 1'- 0"

Basic Fare Structure - Present System

The basic fare structure of the Massachusetts Bay Transportation Authority consists of a rapid transit rate and a surface rate. Therefore, transfer between surface and rapid transit lines requires the payment of an additional fare. However, free physical transfer is provided between all rapid transit lines.

The three rapid transit lines operate wholly within the rapid transit fare zones. Five street care lines, operating through the central subway, also charge the rapid transit rate while in the subway. When operating on the surface they are considered surface lines and charge the surface rate of fare.

A sixth car line, the Ashmont-Mattapan line, operates exclusively on private right-of-way in a suburban area as an extension of the Cambridge-Dorchester rapid transit line. A continuation ride on this line involves no additional fare. Local riding requires payment of a flat fare, equal to other surface lines of the system.

Fare paid within the street car subways are good for a ride as far as the first station outside the subway. The surface fare must be paid for riding beyond this point.

Basic Adult Rates of Fare

Urban Rapid Transit 25¢
Suburban Rapid Transit 50¢
Surface Bus * and Trackless Trolley 25¢
Surface Street Car 20¢
Highland Branch Express 50¢

*On Surface Bus, zone fares are changed on premium routes.

Discount Fares

Children Under 11
Students with T/Identification and
Senior Citizens are one half the adult fare

Handicapped riders are one half adult fare except during rush hours. 7-9 a.m. and 4-6 p.m. when regular fare is charged.

Children under 11 and students are allowed free transfer by issuance of an identification check upon request.

EXPLANATION

Methods of Collection

A fare transaction involves one of the two following methods of fare collection:

Station Collector

Collectors function primarily as change makers. Collectors do collect half fares, inspect children's identification badges, and free riding passes. There is a turnstile at each primary collection booth as well as an International registering, coin return fare box in which half fares must be deposited.

Rapid transit collectors are on duty from 5:00 a.m. to 1:00 a.m. daily. Street care subway collectors work approximately the same hours.

Turnstiles and Rotary Coinpassers

The use of turnstiles is the most common method of fare collection and is responsible for about 90% of all fares collected. Most turnstiles are of the two-way entrance-exit type and were supplied by either Perey General Electric.

Rotary coinpassers are installed at unmanned entrances. They accept a quarter.

Street Car Operator

All street cars are equipped with Keene registering fare boxes.

EXPLANATION

Design Criteria

a. Selection of elements depends on:

   1. Whether paid or unpaid area

   2. Whether attended or unattended area

b. Although paid areas must be physically separated from unpaid areas, it may be desirable to visually de-emphasize the separation (or design for visual continuity). Various types of fences, fence fabric and methods of installation can be selected by the architect to achieve the desired degree of transparency.

c. The number of turnstiles or rotary coinpassers needed in any particular station will be determined by the MBTA Planning Dept.

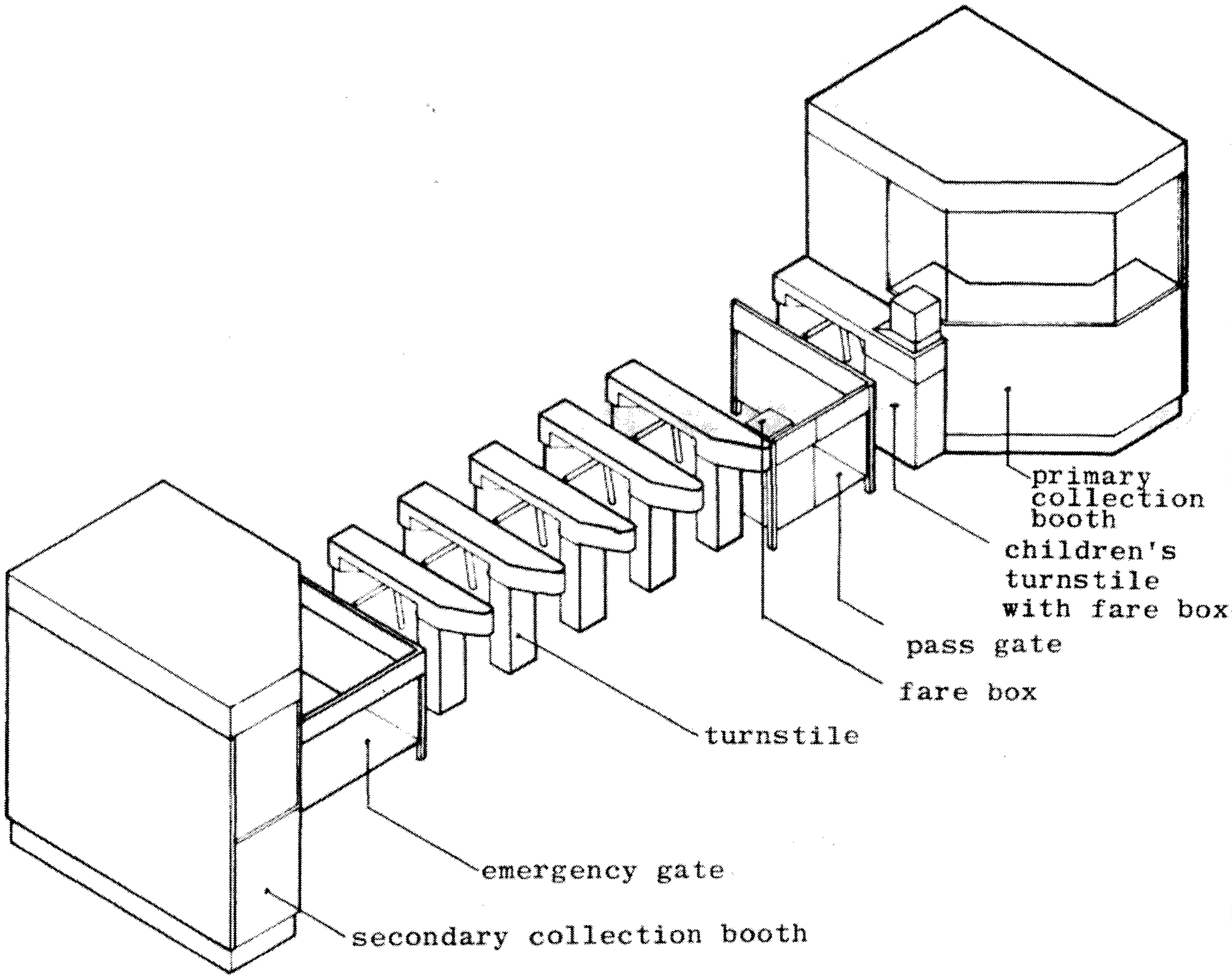
d. Low fencing should be used between paid and unpaid areas only where it will be in the normal field of observation from a primary collection booth; otherwise high fencing is required. High fencing should be at least 6'-10" high, and should extend to the ceiling in low headroom areas.

e. A 9" high metal band appears at waist height (3'-2") in the turnstiles and on adjacent fencing. In fare collection lines, low fences should have a band of stainless steel, reflecting the adjacent turnstile band material and affording better durability in these high public contact areas. High fencing, if divided horizontally, should have a similar 9" band, painted with the fence frame, and set at the same 3'-2" elevation.

f. Emergency gates and maintenance gates may be combined at major access and egress points. As long as the opening is 4'-0" or more, one gate is sufficient for both functions.

g. Fences, gates, and solid barriers should be designed so that their height relates to the vertical dimensions established by the exit gates and other components.

h. Rotary coinpassers present a considerable obstruction to traffic flow, and should be used only where a fare collection line with turnstiles and collection booth is out of the question.



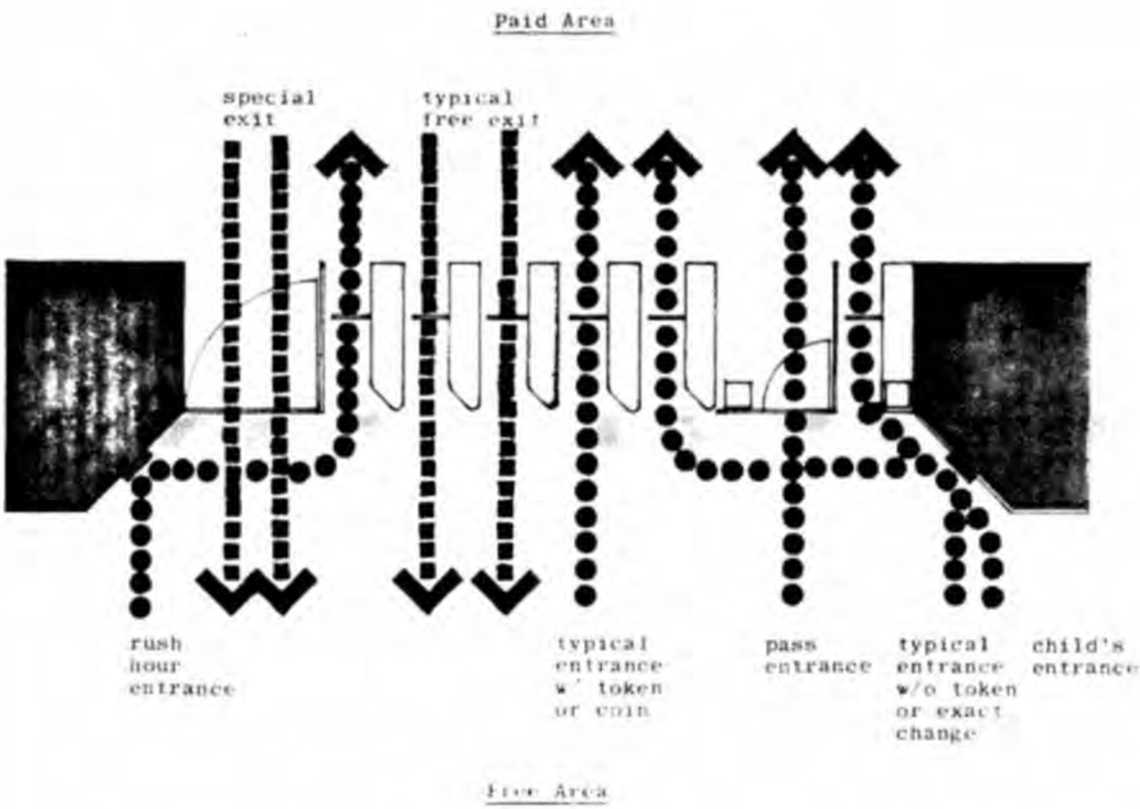
Fare Collection Sequence

The typical fare collection line consists of the following elements:

a. Primary collection booth
b. Children's turnstile and fare box
c. Pass gate
d. Token-operated turnstiles

Optional elements consist of a (1) secondary collection booth which generally operates during peak periods only and does not normally have a children's turnstile connected to it. (2) Emergency gate to provide access for emergency equipment and maintenance vehicles between the paid and unpaid areas. (3)Fare box used in conjunction with pass gate. The emergency gate does not normally occur in the fare collection line, but may be included when no other options exist.

DESIGN CRITERIA

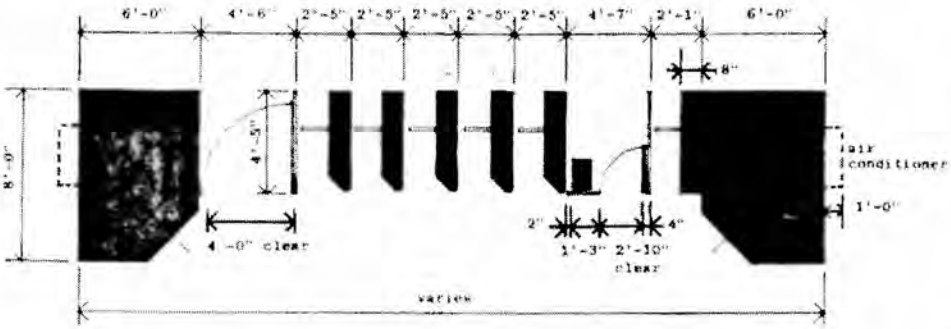


Inner-City Station - Pay Enter, Free Exit

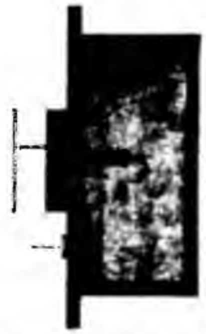
Fare Collection Circulation

The zones of typical circulation are shown and should be considered in any alteration of the typical line. Circulation paths should be kept clear and free from conflict.

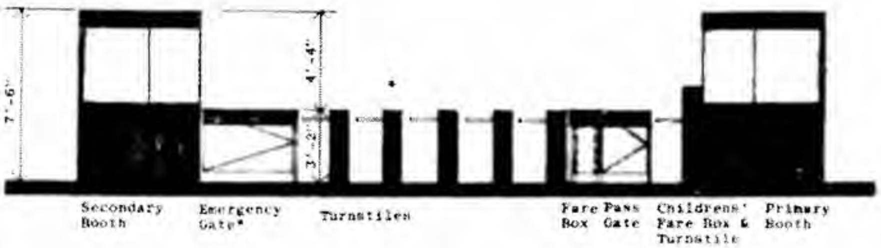
Typical Layout



PLAN



PLAN (Built-in booth)



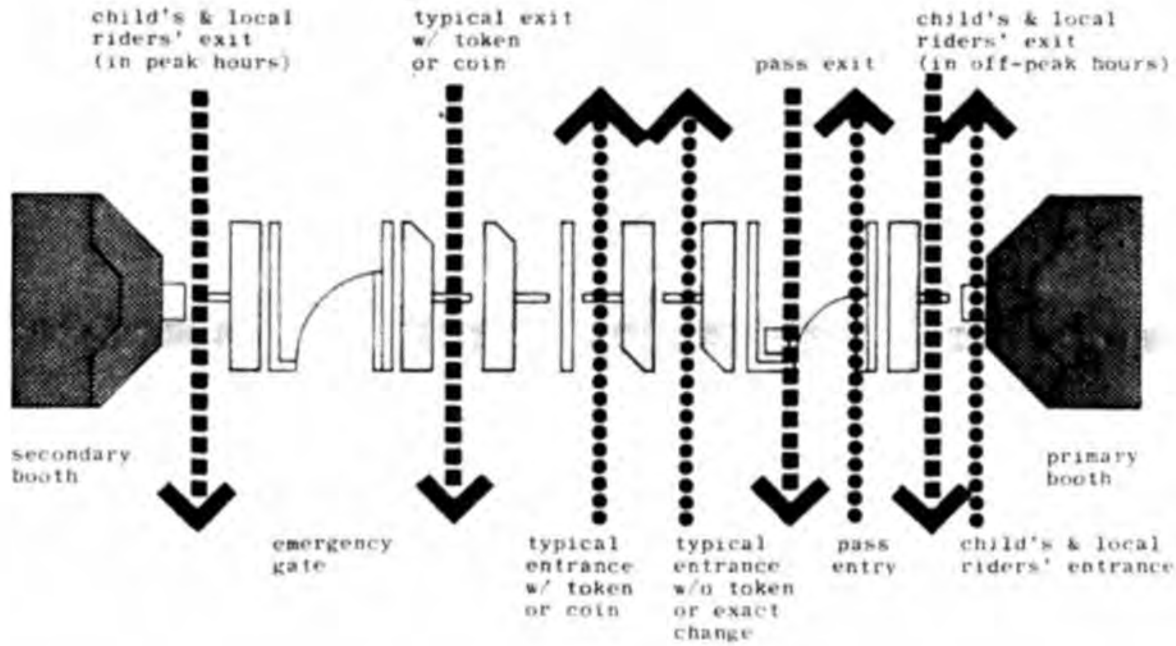
Section (Built-in booth)

*Emergency gate included in line only if no alternative position exists.

Inner City Station - Pay Enter, Free Exit

TYPICAL FARE COLLECTION LINE WITH DIMENSIONS

Paid Area

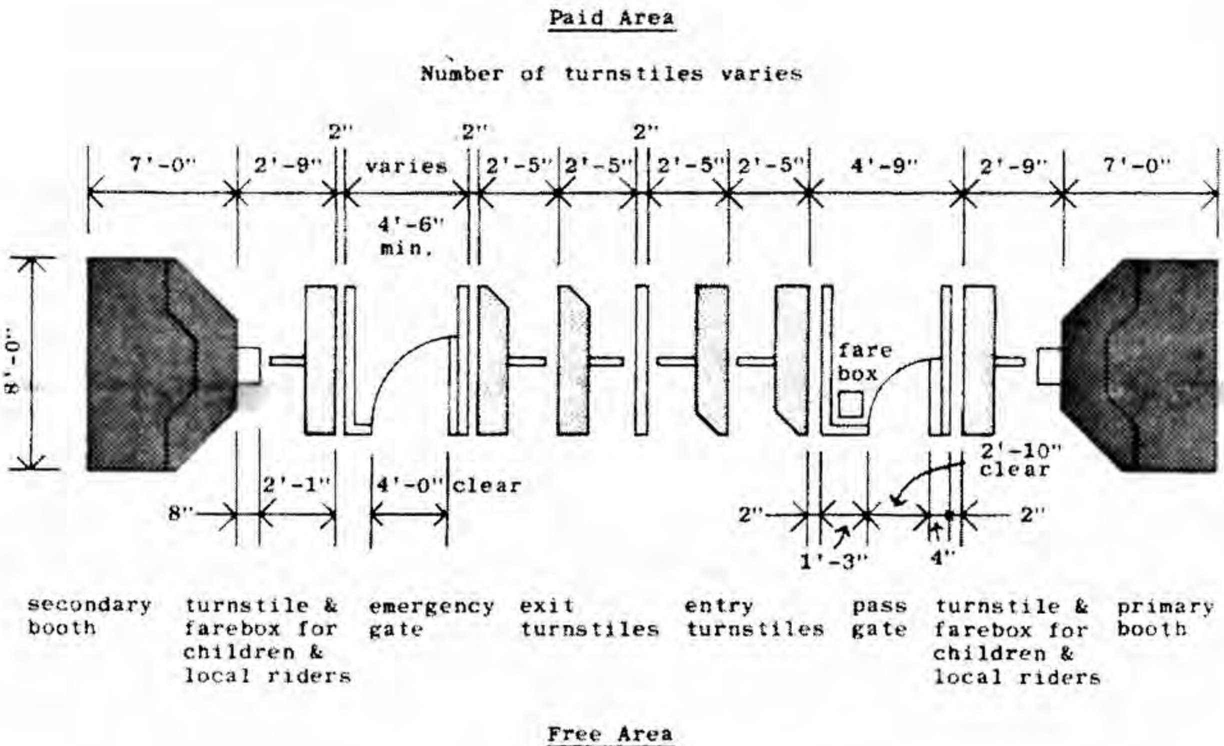


Free Area

Suburban Station - Pay Enter and Exit

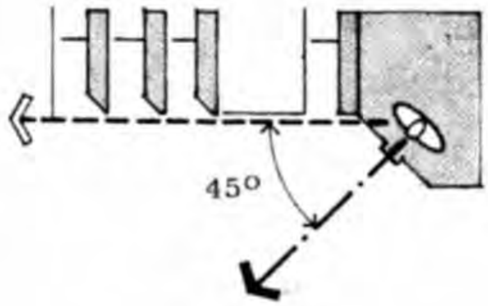
Fare Collection Circulation

TYPICAL LAYOUT

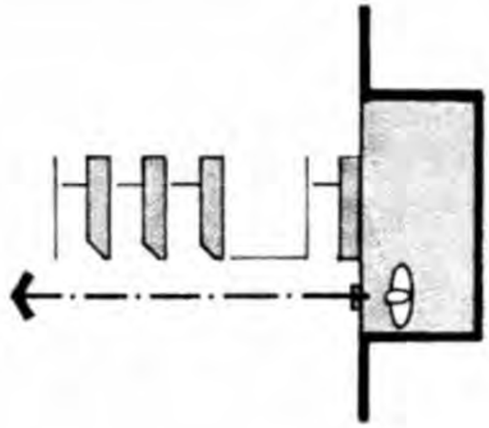


Suburban Station - Pay Enter and Exit

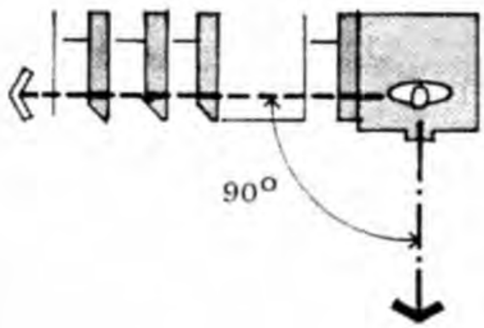
TYPICAL FARE COLLECTION LINE WITH DIMENSIONS



STANDARD BOOTH



BUILT-IN BOOTH

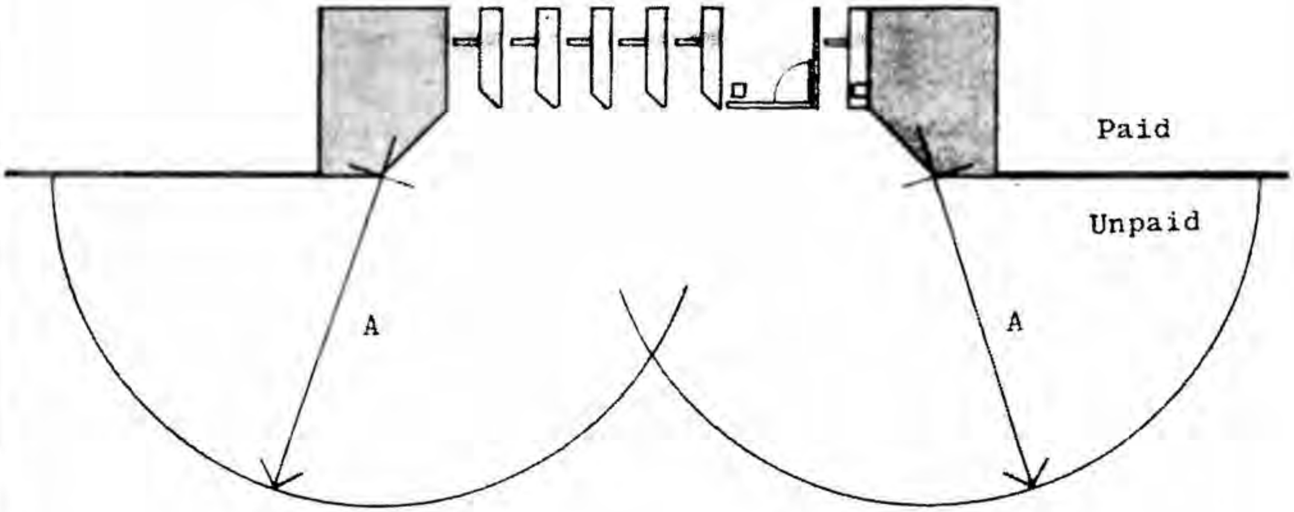


UNACCEPTABLE BOOTH

<u>Fare Collector's Sight Lines</u>

Variations on the fare collection line depend on the physical limitations of the station. In all cases the fare collector should be able to see clearly down the line of equipment with out moving his head more than 45° from the frontal position as in A and B above. An angle of more than 45° as in C above is unacceptable.

<u>DESIGN CRITERIA</u>



1. In general, the primary collection booth should be on the right, to permit right hand circulation. If circulation is thereby improved, it can be on the left.

2. Required queue space: Dimensions A (20' minimum at downtown stations, 15' minimum at suburban stations). This space is in addition to required runoffs for stairs and escalators, and to such space for through circulation as may be required by the station plan. Queue space is required at both booths.

3. Individual station plans and expected rush hour circulation patterns will establish the position queues will take. Queues must not prevent patrons already possessing tokens from direct access to the turnstiles, nor obstruct exiting from swing-type exit gates that many be opened during rush hours.

DESIGN CRITERIA - Queue space

General Description

Collection booths are the major components in the fare collection line, and are required in every station. They are enclosures from which the collector sells tokens, and supervises the collection line. Booths are of two types, freestanding and built-in, with built-in preferred if circulation allows.

General Requirements

At each fare collection line there is one primary collection booth, which may be augmented by one or more other booths, callecd secondary collection booths. Secondary booths function only during peak circulation hours and do not usually have provision for the collection of children's fares. Secondary booths are also called token booths.

The location of the booth is of primary concern. It must be positioned to provide an easy and natural sequence from the purchase of tokens to the arrival at the platform.

The children's turnstile must be physically connected to the primary collection booth. In some heavy traffic situations, a children's turnstile may be installed with a secondary booth.

The collection booth requires special equipment consisting of controls, alarms, major switches, signal devices, public address equipment, and telephone. The primary booth contains a cash safe which the collector uses at the end of each shift. It may contain one or more TV monitors. When secondary collection booths are use, the operators of these booths use the cash safe in the primary collection booth.

Collection booths have floors raised by 4" or 6" above the mezzanine floor level, to permit better observation by the collector.

General Description

Freestanding collection booths of bullet-resistant design will be furnished by the Authority or the Contractor, and set up in place either by the Authority or by the Contractor. Certain equipment will be furnished with the booth, and the Contractor shall provide and connect power and communication lines to serve this equipment, as well to serve other items of equipment furnished by him. The secondary booth is similar to the primary except that certain items of equipment may be omitted, as explained below.

Equipment Furnished with the Booth

All conduit and pull for installed or anticipated Equipment, separate for AC, DC, and signal
1-Main Breaker Panel
1-Exterior Duplex Outlet
1-151 Watt Incandescent DC Emergency Fixture - 660 watt/600 Volt Socket, with Conduit and Junction Box
3-22 Watt Circular Flourescent Fixtures
Lighting Fixture W/2 - 24" Flourescent Lamps
Coinplate, Counter Tops, Cabinets, Coat Hooks
Heating, Ventilation & Air Conditioning Equipment

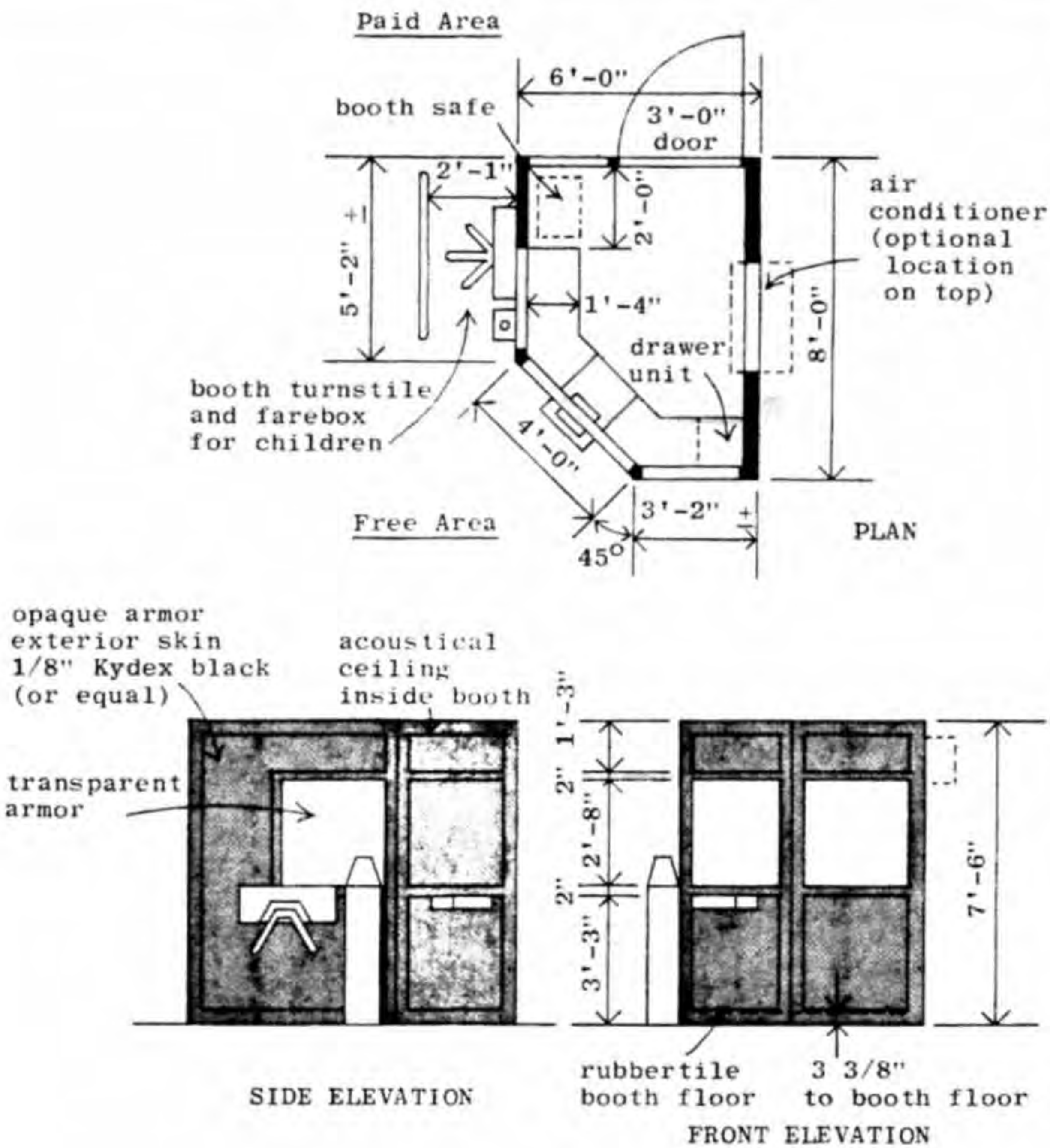
Temperature:	Maintain 70° minimum in winter months. Maintain 78° maximum in summer months. Use water-cooled condensers below grade, and air-cooled condensers above grade with good ventilation. Heat pumps with supplemental electric heat.
Humidity:	Fifty percent maximum in summer months; use electric reheat. No control in winter months.
Ventilation:	Provide 20 to 25 CFM outside air. Maximum residual air velocity in occupied area of 50 feet per minute. Maintain small positive pressure in room. All ventilation shall be mechanical and run when booth is occupied.

Equipment Furnished by the Contractor

(primary booth only, unless otherwise noted)
1-Telephone (primary and secondary booths)
1-ADT Alarm (if required)
1-Starters Call Button (primary and secondary booths)
1-Starters Call Bell (mounted on the primary booth)
1-or more TV Surveillance system monitor sets and controls (if required)
1-or more emergency exit alarms (if required)
Sound System Equipment and Monitor Loudspeaker
Other equipment and connections as may be required

COLLECTION BOOTH - Freestanding

Built-in booth has similar requirements

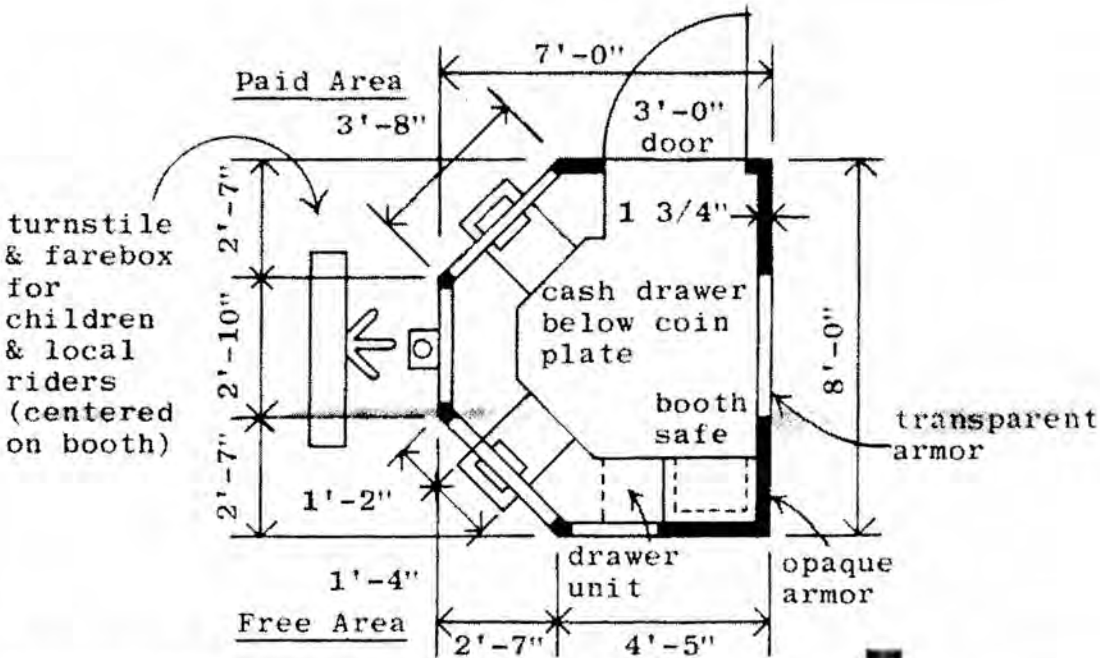


All metal trim and frames to be black anodized aluminum.

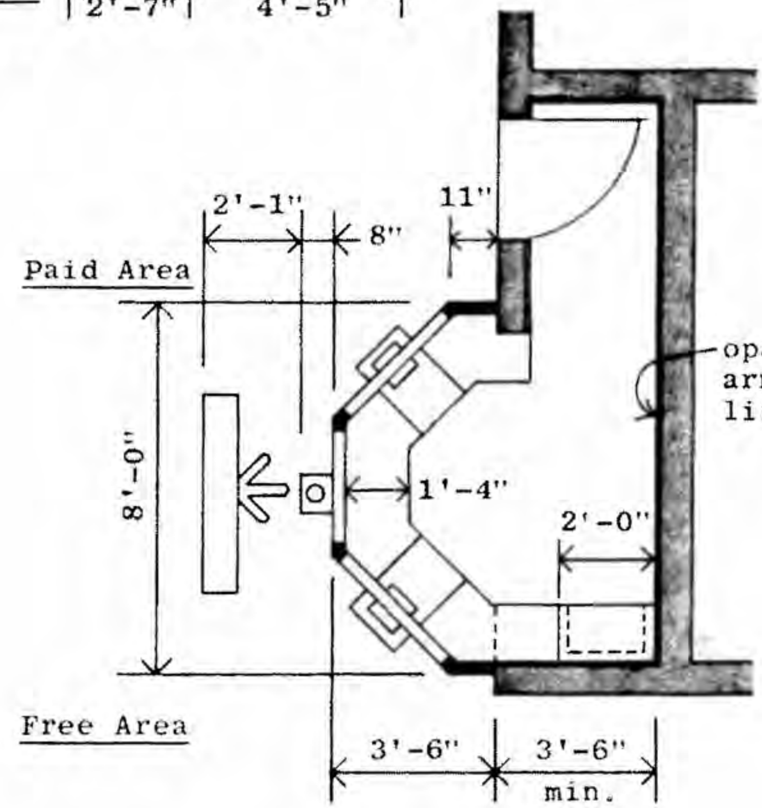
Reference: T Drawing M-a-24368

<u>INNER CITY STATION - Pay Enter, Free Exit</u>

<u>COLLECTION BOOTH - Freestanding</u>



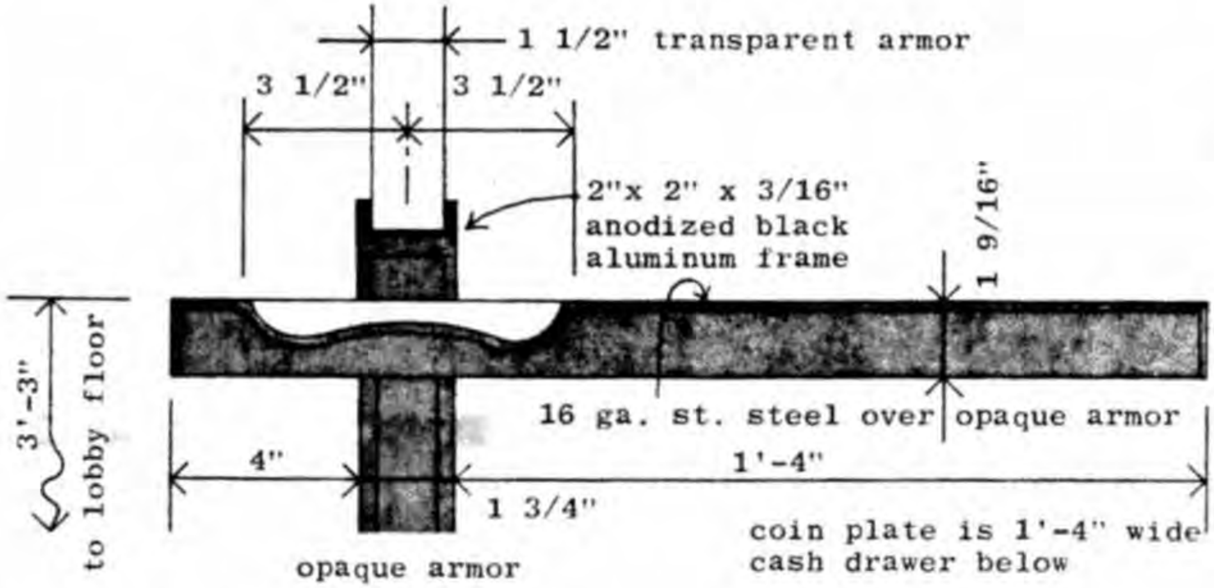
Freestanding Booth



Built-in Booth

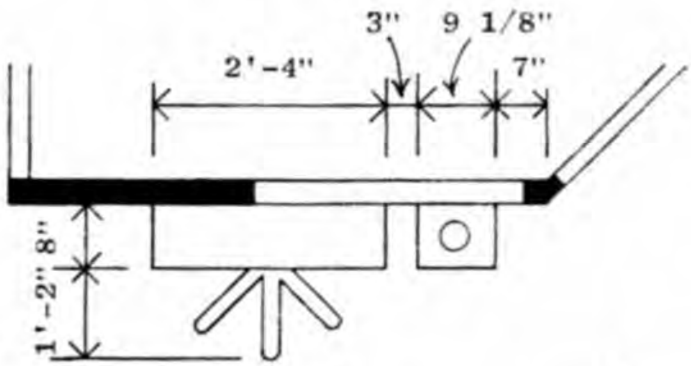
SUBURBAN STATION - Pay Enter and Exit

COLLECTION BOOTH - Freestanding and Built-in

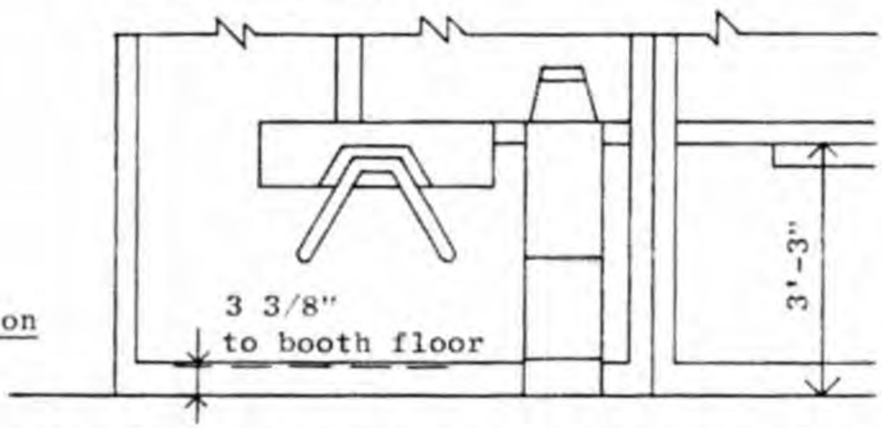


Coin Plate Detail

Plan



Elevation



Booth Turnstile and Farebox - Inner City Station

COLLECTION BOOTH - Details

A. Environmental Control

1. Exhaust fan *	in built-in booths, the Authority will furnish a counter mounted fan.
2. Lighting - normal (AC) *	1 Type N over counter and backlighting sign strip. Other fluorescent or incandescent as required.
3. Lighting - emergency (DC) *	1 or more - 151 w. downlight, equal to McPhilben 3-10B
4. Heater *	2 1000 w. equal to Chromolox HV 2411
5. Switches *	one each for lighting and each heater
6. Convenience outlet *	duplex
7. Fresh air supply *	wall or door grille.6" max. in one dimension, or with steel protective grating provide means of winter close off

B. Communication

1. Telephone	wall type, connected to central MBTA switchboard
2. ADT alarm **	connected to cash safe and ADT headquarters, via telephone lines.
3. Emergency exit alarm **	buzzer actuated by opening of emergency exit
4. TV surveillance system **	monitor set(s) counter mounted
5. Sound system	microphone, monitor loudspeaker, VU meter and variation control, volume control
6. Starters' call bell	button actuating remote call bell

COLLECTION BOOTH EQUIPMENT

C. Operating Aids

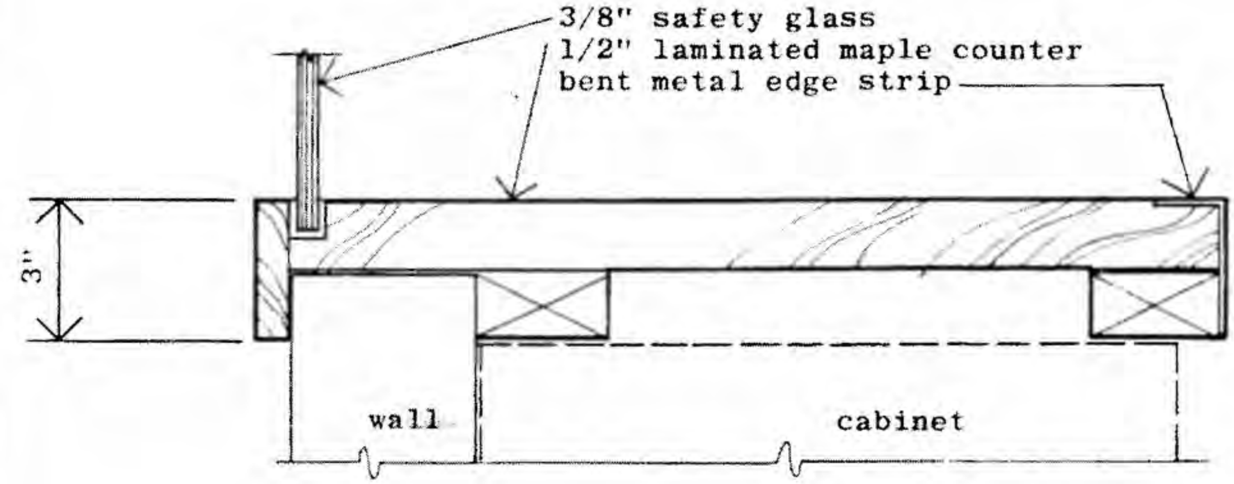
1.	Coathook strip * (**)	3 hooks located away from public view
2.	Bulletin board * (**)	door or wall mounted, away from public view
3.	Collection booth cabinet *	see sheet B3.8
4.	Cash safe (**)	furnished by Authority
5.	Children's turnstile with pedal, coin return (**)	furnished by Authority

Refer to Sheet 3.4 for preferred equipment locations

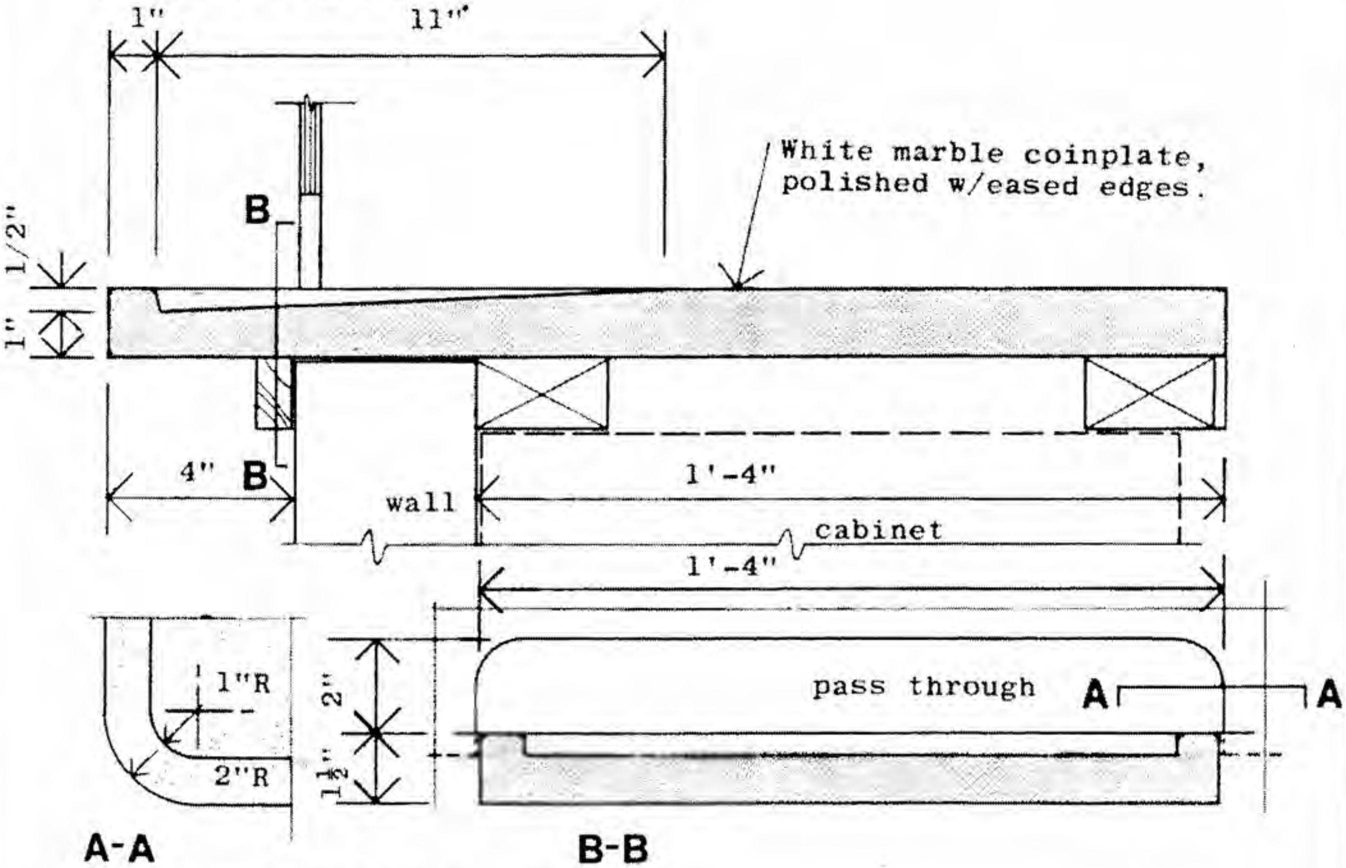
All equipment listed is to be furnished by the Contractor, except: * items are Authority furnished with the free-standing booth only. Remarks therefore apply only to built-in booth.

All equipment listed is required in both primary and secondary booths, except:
** items are required in primary booth only.

COLLECTION BOOTH EQUIPMENT

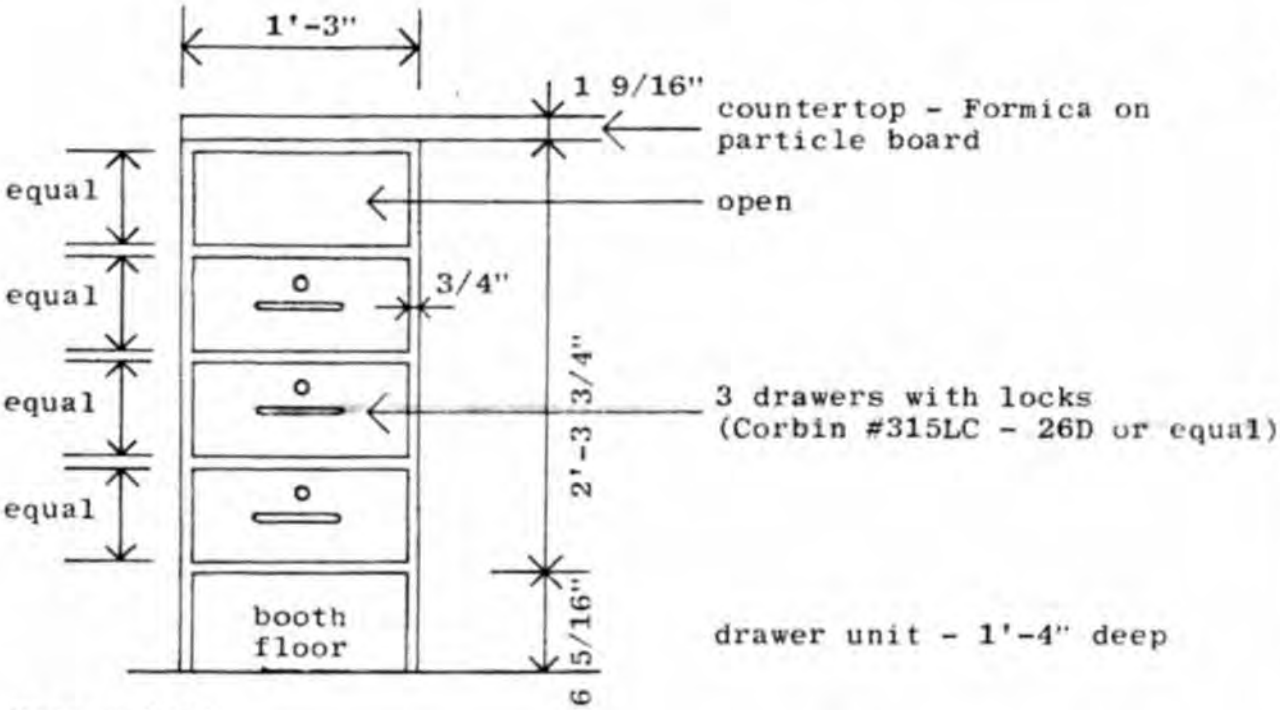


Section at Countertop

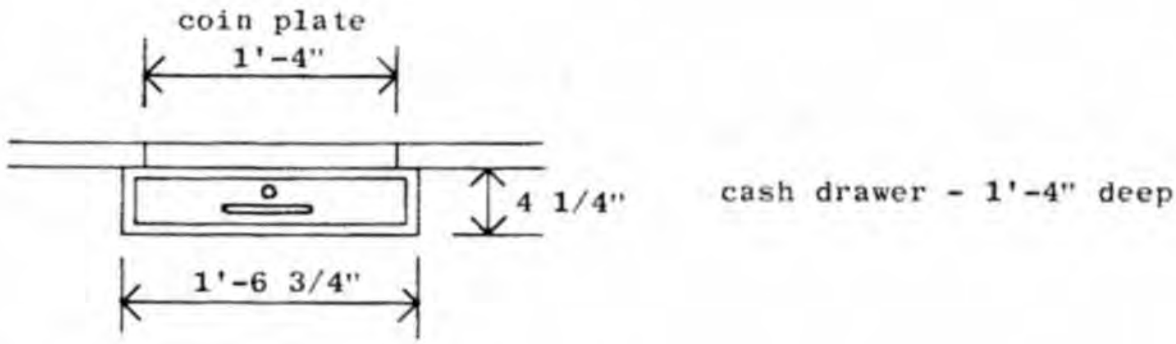


Sections at coinplate

COLLECTION BOOTH



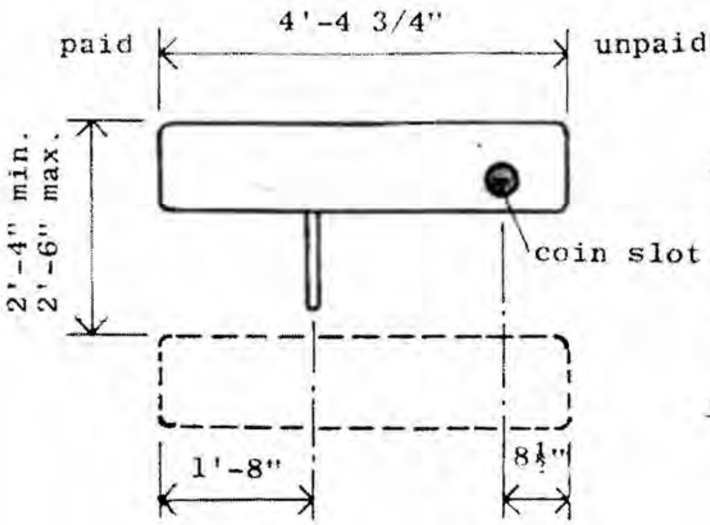
Drawer Unit



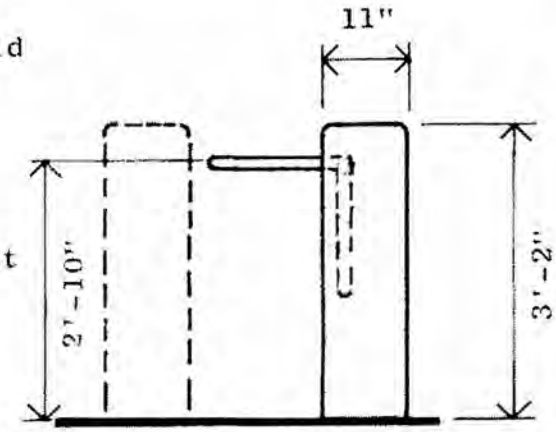
Cash Drawer

1. All wood to be 3/4" hardwood or hardwood plywood, except drawer bottoms 1/2" and dividers 1/4".
2. Construction to be equal to American Woodwork Institute, Custom Grade.
3. All drawers to have pulls and nylon slides.
4. Personal property drawers to have cylinder locks.
5. Cash drawer divided into 4 bill compartments.

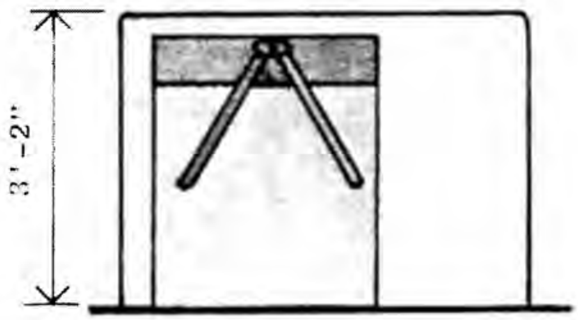
COLLECTION BOOTH - Details



PLAN



FRONT ELEVATION

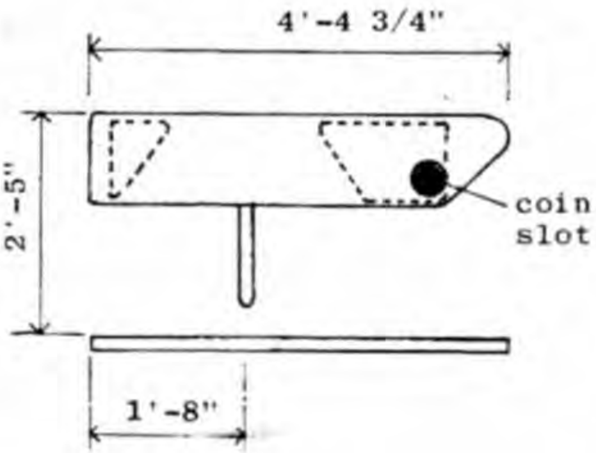


SIDE ELEVATION

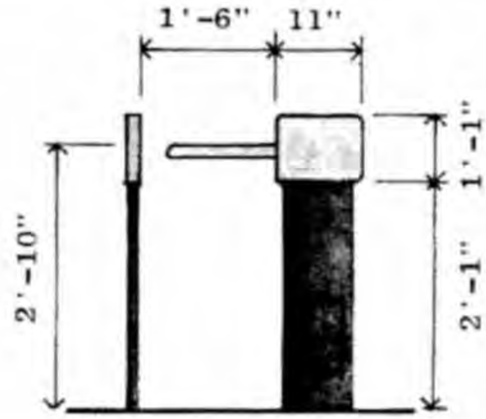
Existing Turnstile

The coin-operated turnstile is the basic fare collection device in the transit system. Perey Model 97 Kompak Coin-passer turnstiles are used widely throughout the existing stations. Occasionally a station may have older electric GE turnstiles. The turnstiles are arranged for token operation in the entering direction and are free-turning in the existing direction. The mechanism is unlocked by an MBTA token only and requires no electrical connection.

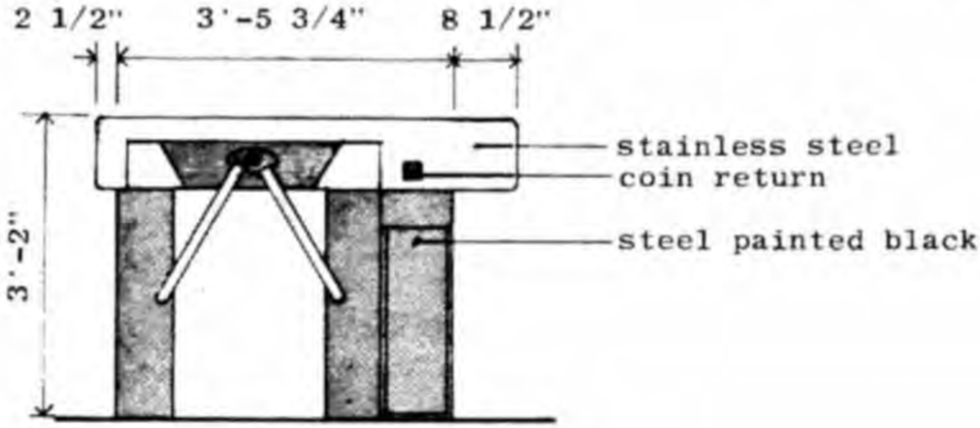
TURNSTILES scale 1/2" = 1'-0"



PLAN



FRONT ELEVATION



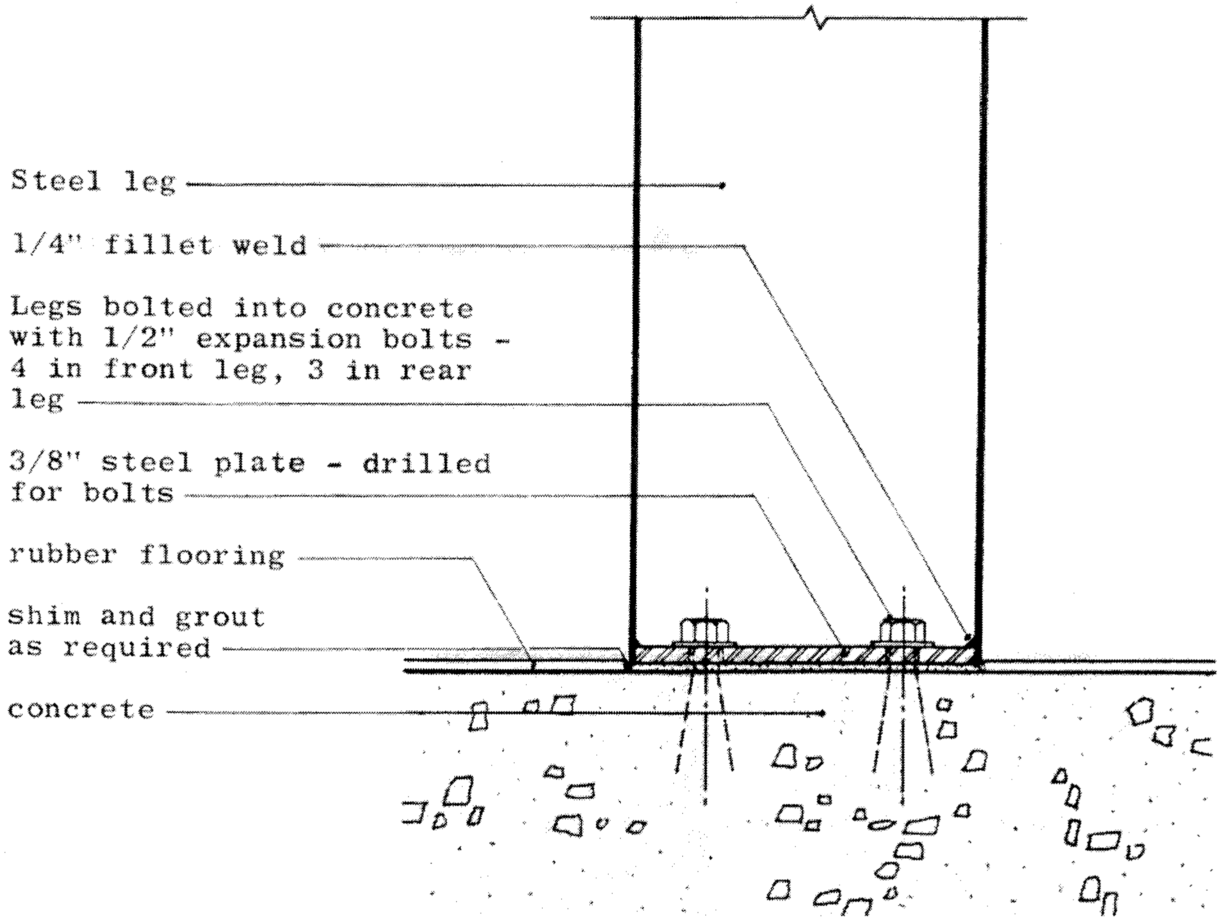
SIDE ELEVATION

New Turnstile

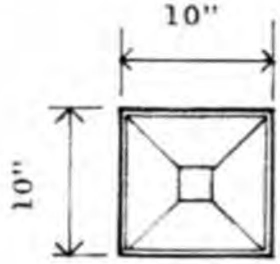
The coin-operated turnstile is the basic fare collection device in the transit system. Perey Model 97 Kompak Coin-passer turnstiles are used widely throughout the existing stations. Occasionally a station may have older electric GE turnstiles. Some modernized and new stations will have new turnstiles, as shown here. The turnstiles are arranged for token operation in the entering direction and are free-turning in the existing direction. The mechanism is unlocked by an MBTA token only and requires no electrical connection.

TURNSTILES

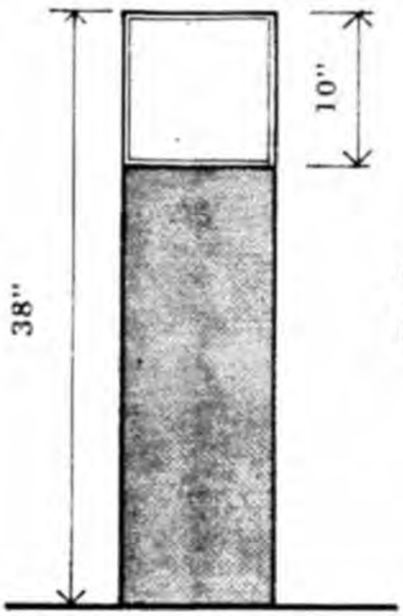
Turnstile Base Detail



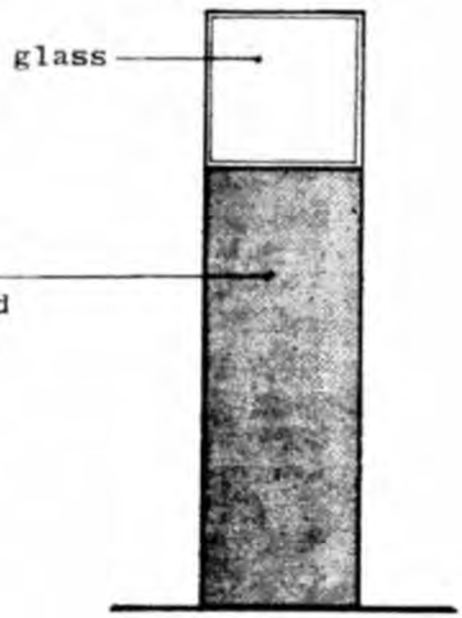
TURNSTILES scale 3" = 1'-0"



TOP



FRONT

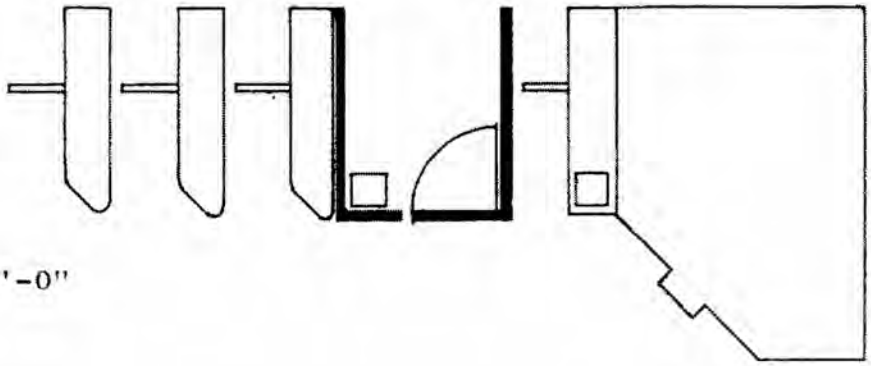


SIDE

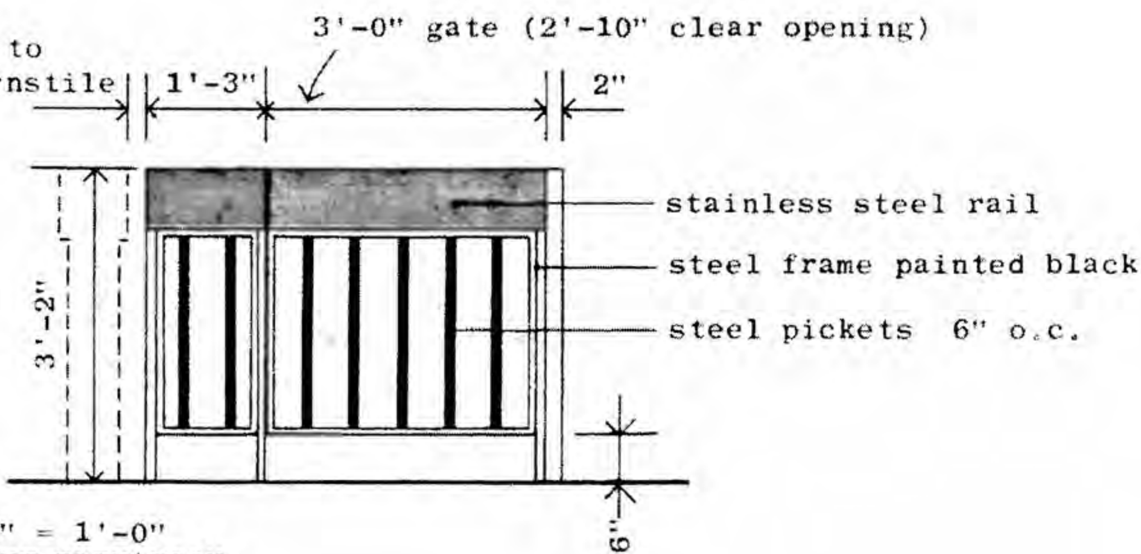
Fare Box

At certain times of heavy use the passgates are opened and used for fare collection. The fare is placed in free-standing fare boxes which have tops that allow attendants to visually check fares and spot illegal coins. Fare box requires electrical connection (120 v AC, 1/20 hp motor)

FARE BOX scale 1" = 1'-0"



1/4" = 1'-0"
PLAN



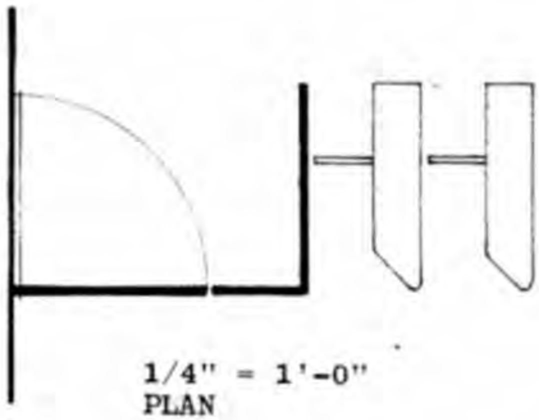
1/2" = 1'-0"
FRONT ELEVATION

Pass Gate

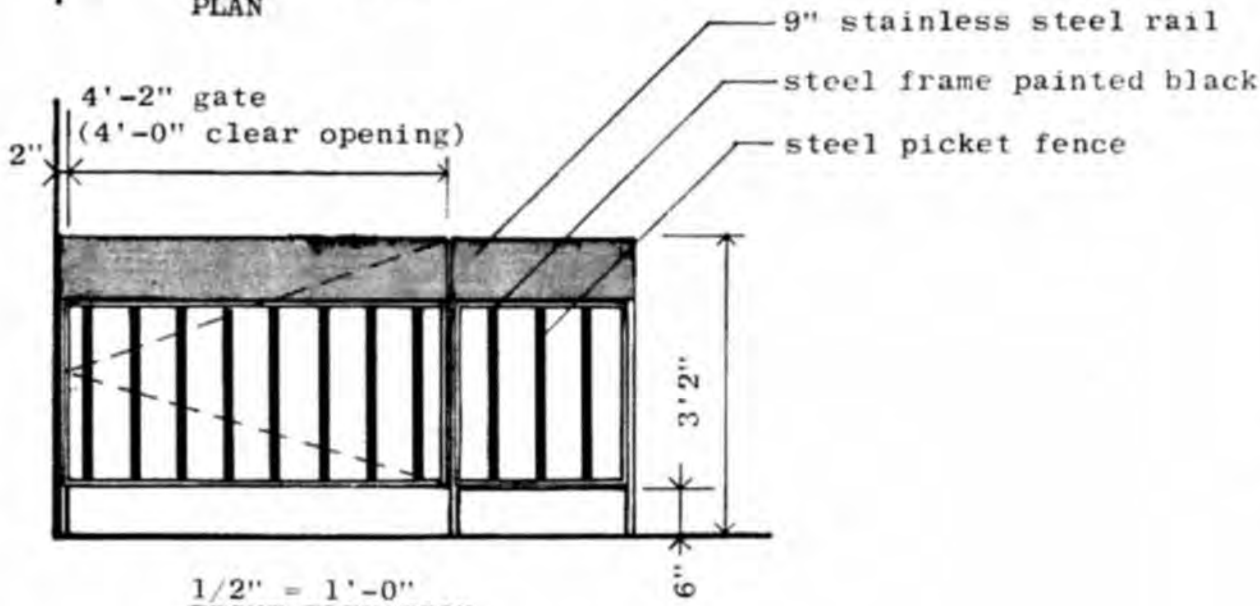
On occasions such as sporting events or other peak circulation situations the pass gate may be opened and fares collected by an attendant with a fare box. This gate may also be used to facilitate exiting in circulation surges.

The gate must spring closed and the latch is always operated from paid side of gate. Install a hook and eye to hold the gate open.

BARRIERS



1/4" = 1'-0"
PLAN



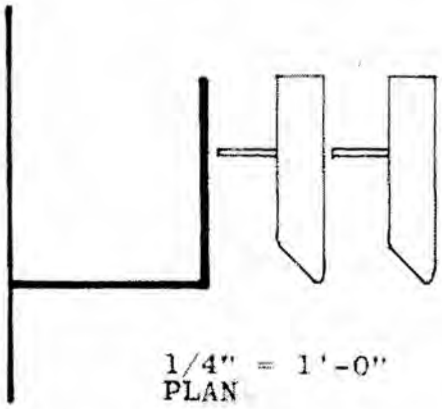
1/2" = 1'-0"
FRONT ELEVATION

Emergency Gate - Low Type

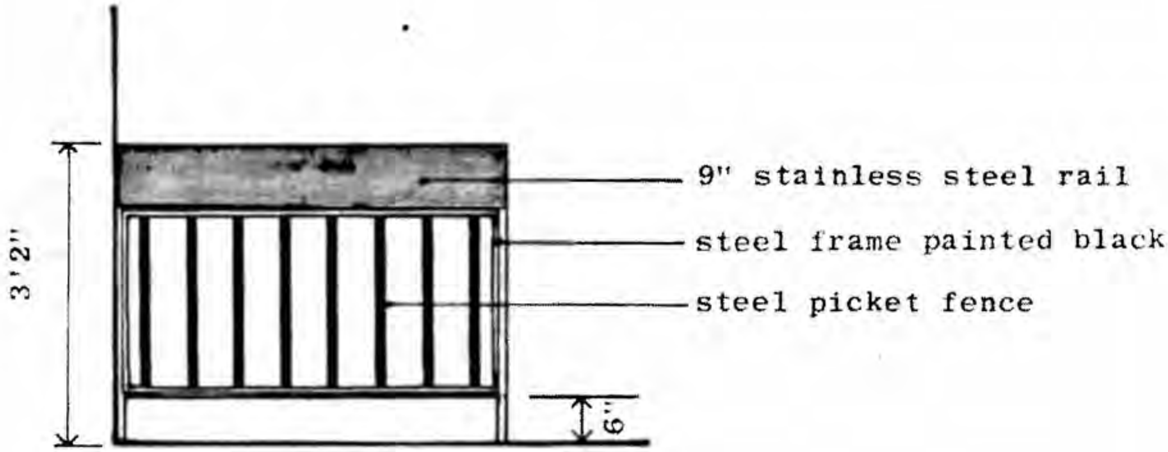
Access for emergency and maintenance equipment must be provided from unpaid to paid area at or near every fare collection layout. Emergency gates are 4'-0" wide, clear, and are best located where they can be opened (and manned) for easy exiting during rush hours. Low type gates can be used only where they are in normal direct vision from collection booth.

Emergency gates should have a lock and a wall stop and holdback.

BARRIERS



1/4" = 1'-0"
PLAN

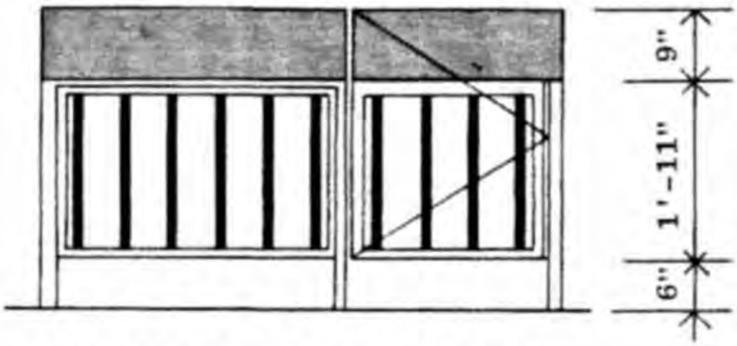


1/2" = 1'-0"
FRONT ELEVATION

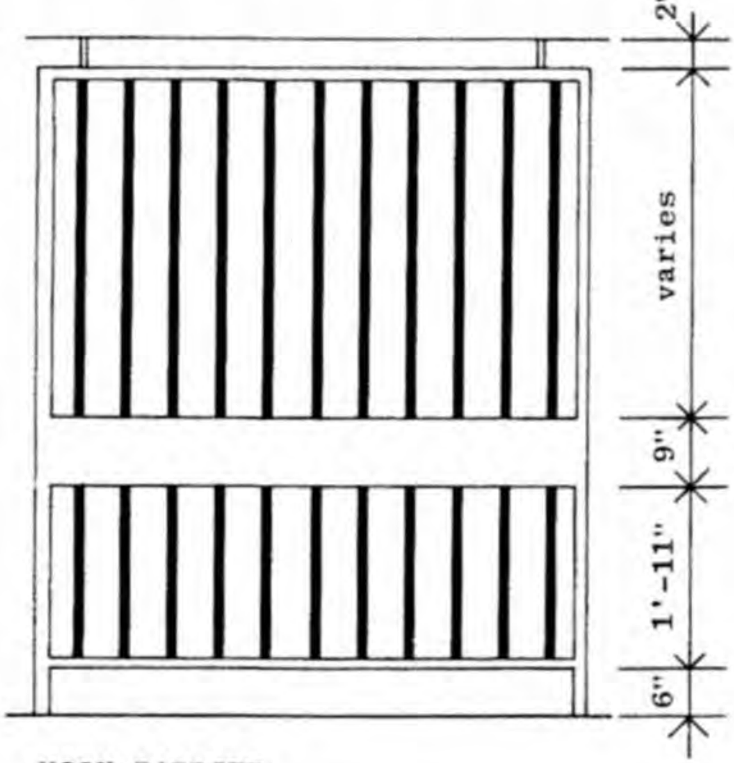
Fixed Barriers - Low Level

The low type barrier separates the paid area from the unpaid areas in the fare collection line or in other supervised situations. It must relate to other fare collection elements (see fare collection line).

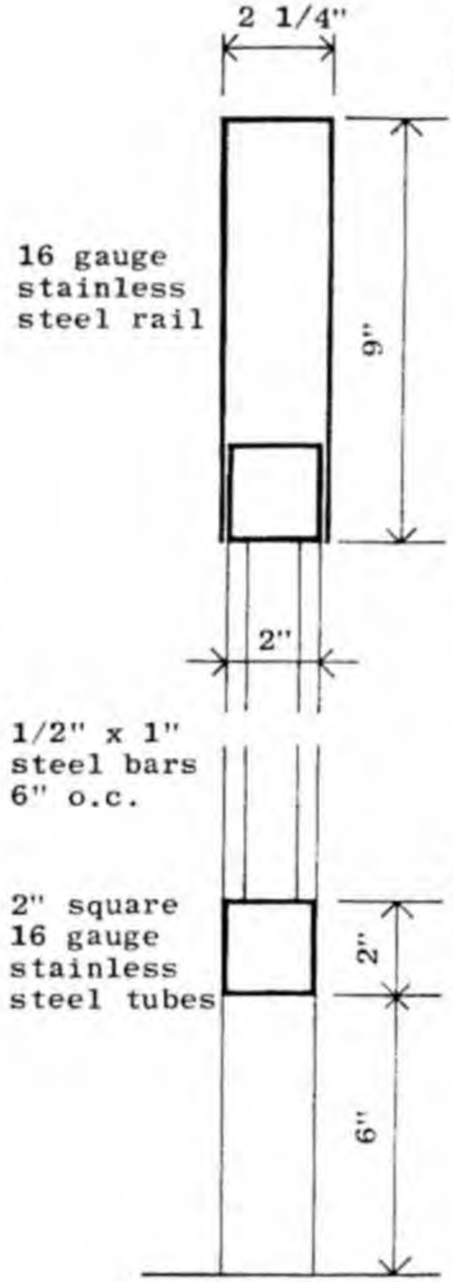
BARRIERS



LOW BARRIER WITH PASS GATE



HIGH BARRIER



SECTION

2" square steel
tube frame
and pickets
painted black

BARRIERS - Suggested Detail

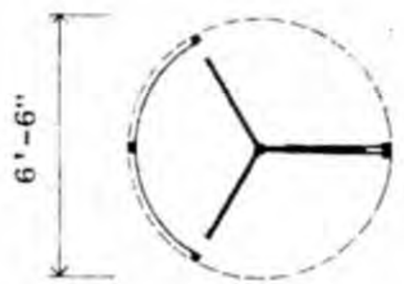
Stainless Woven Wire

Stainless woven wire will be used only in fare collection barriers. All other fences will be the steel picket type. The following specifications should be used for stainless woven wire fences.

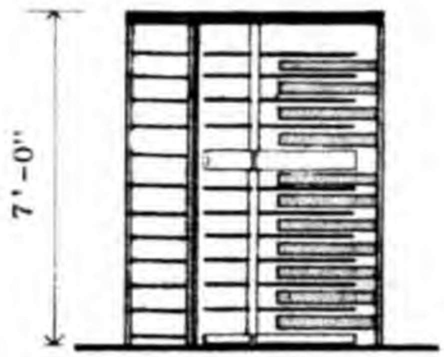
Woven wire panels, fare, and partition inserts, shall be fabricated of stainless steel, and shall consist of stainless steel wire diamond mesh of #12 stainless wire 1-1/8" wheels-diamond mesh, set in steel channnel (not stainless steel) frames, sized as indicated. They shall be manufactured by Acorn Wire and Iron Works, Haskins-Haire Wire Works, Bellis Wire Works, or equal approved by the Authority.

Framing for woven wire partitions, to receive steel channel frames mentioned in the previous paragraph, shall be fabricated of steel sections (not stainless steel) as shown, in accordance with the details. Include all posts, mullions, rails, sills, tubular headers, flat-plate headers, steel rod hangers (to ceiling), angles, flat stock, and all necessary fastening devices and anchors. Use continuously welded, ground-smooth construction throughout except where other methods are shown. Secure stainless steel insets to steel framing by means of stainless steel flat head, bolts into tapped holes, following manufacturer's recommendations.

Stainless steel railing at low woven wire partitions shall be accurately formed to the dimensions shown, with welded-on end caps, and all welds ground smooth and finished to match the adjacent surface.



PLAN



ELEVATION

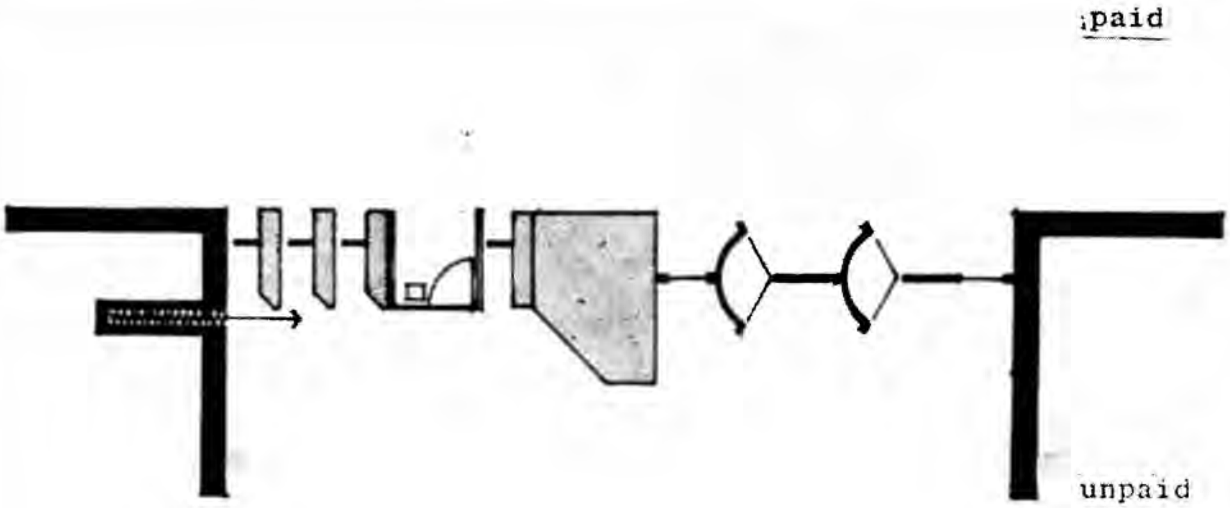
Material:

Stainless steel and black painted steel.
Floor material continuous under exit gate.

Rotary Exit Gate

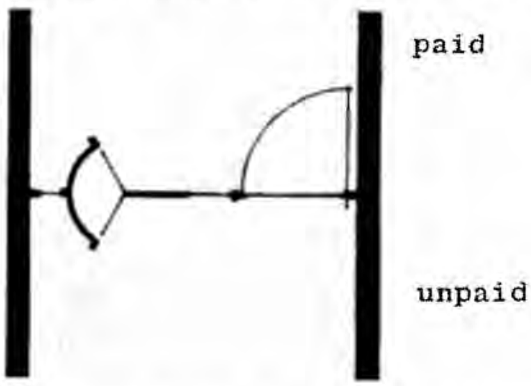
In situations where exits are located out of direct visual supervision, rotary exit gates should be installed. The shaft with gate arms is free to rotate in only one direction, permitting continuous egress from the paid area without permitting unpaid admittance.

ROTARY EXIT GATE Scale 1/4" = 1'-0"



a. PART TIME FARE COLLECTION LINE WITH ROTARY EXIT GATES

b. ROTARY EXIT GATE REMOTE FROM FARE COLLECTION LINE

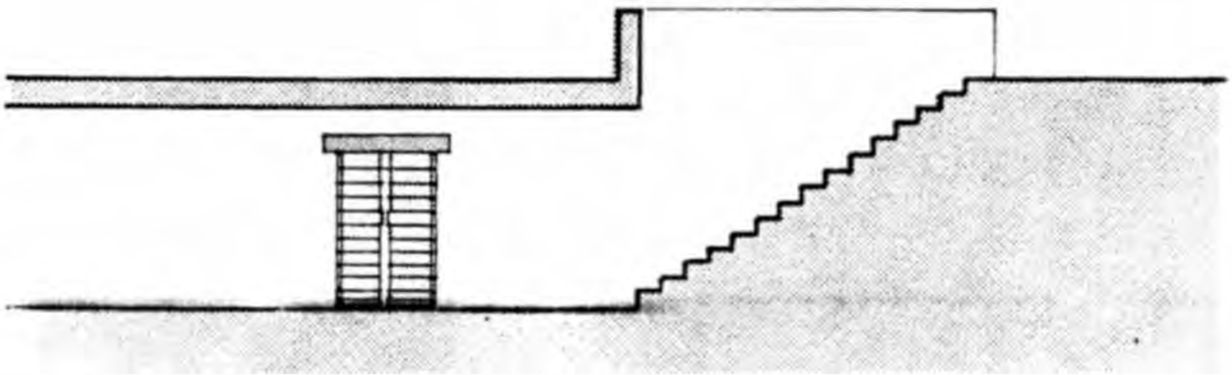


Special Rotary Exit Gate Installation

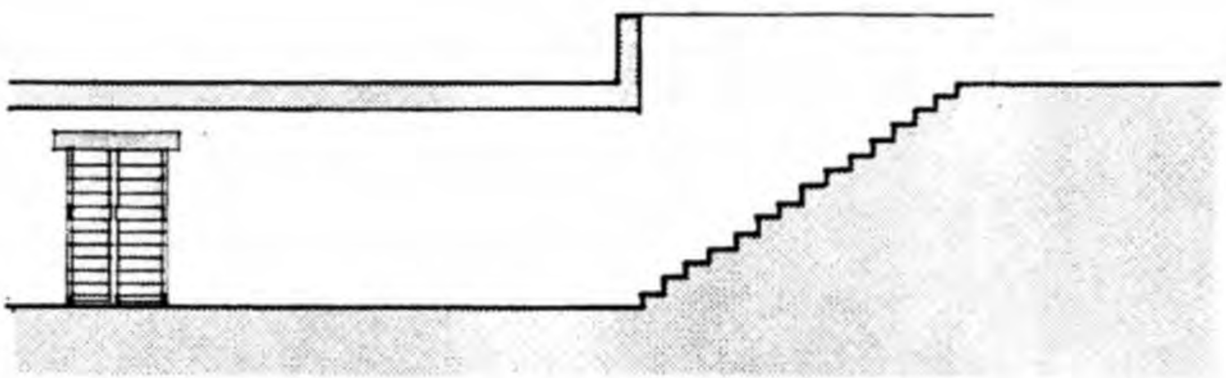
a. At fare collection lines manned only during hours of peak traffic, rotary exit gates are installed to permit exiting at any hour. For such part-time collection lines, a rolldown or swing-out close-off must be provided to prevent access to the paid area.

b. At instances where the fare collect on line is remote from an exit, and the line is manned only during peak hours, it is desirable to enclose as much of the corridor within the paid area as possible. In such cases a rotary exit gate would be installed close to the exit, with a swing gate which would be fixed open during the peak hours. No close-off at the collection line, as described in a. above would be required.

ROTARY EXIT GATE scale 1/4" = 1'-0"



EXIT GATE VISIBLE FROM SURFACE - Preferred



EXIT GATE NOT VISIBLE FROM SURFACE

Where a surface structure is used as an exit, a rotary exit gate may be installed near the surface level. This prevents entrance from the street level and discourages loitering in the stairs and passageways by making them paid rather than unpaid areas

ROTARY EXIT GATE   scale 1/8" = 1'-0"

Platform Lengths

1. Green Line: Existing stations vary from 135' to 440'. Minimum length for 4 LRV's @ 73'/car plus 8'= 300'. Each station should be reviewed with the Authority for special conditions.

2. Red Line: Existing stations vary from 267' to 435'. New and lengthened stations will allow for 6 car trains @ 70'/car plus 20' = 440'.

3. Blue Line: Existing stations vary from 187' to 350', which will accommodate 4 car trains @ 50'/car. Ultimately longer trains may be necessary. New and lengthened stations will allow for 6 car trains @ 50'/car plus 20' = 320'.

4. Orange Line: Existing stations vary from 305' to 480' and are presently served by 4 car trains @ 55'/car. New and lengthened stations will allow for 6 car trains @ 65'/car plus 20' = 410'.

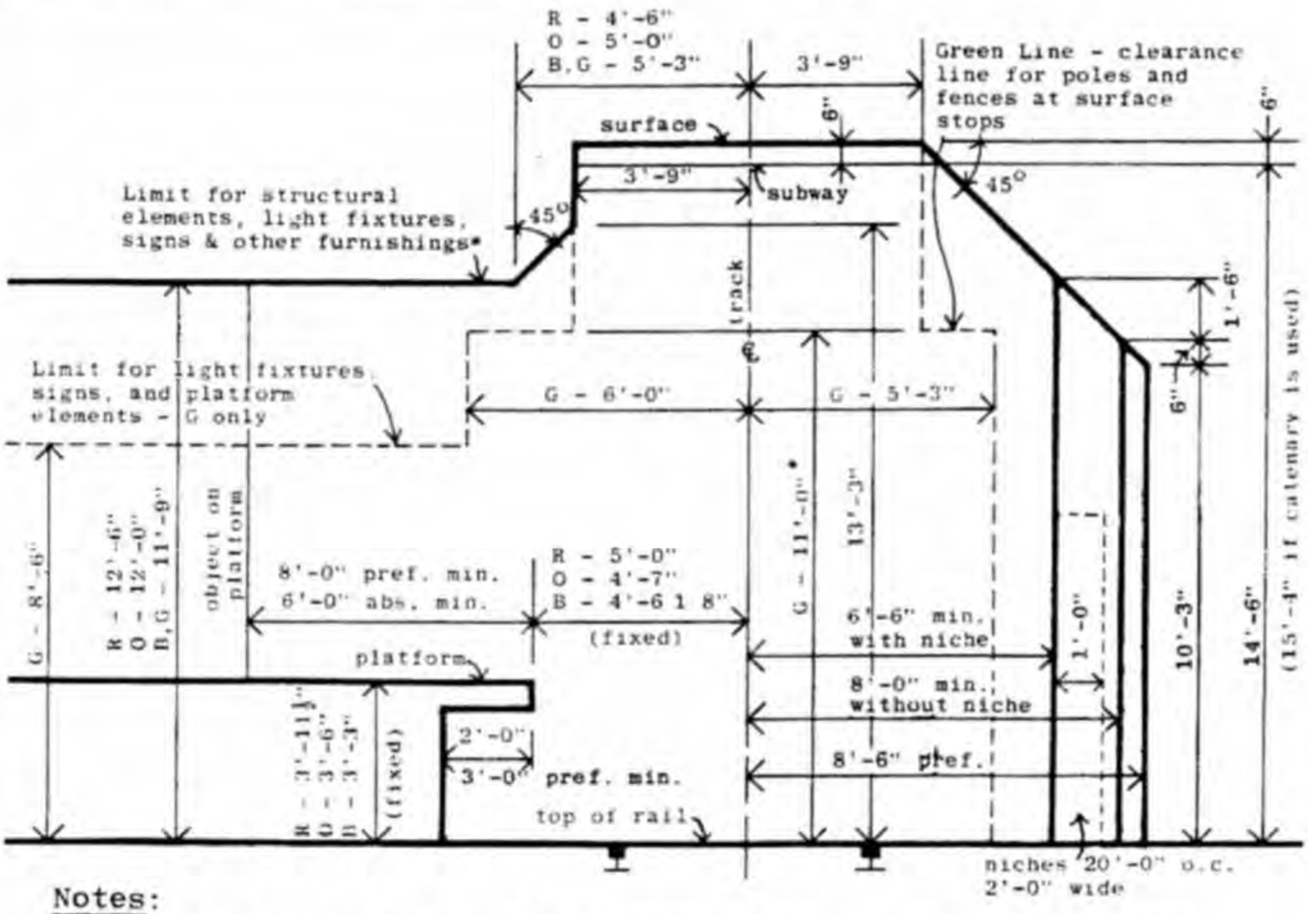
5. See IV E2 for emergency exit criteria applicable to all stations.

PLATFORM AREAS - Design Criteria

Minimum Headroom Requirements

1. Structure over tracks -- 15' from top of rail.
2. Train platforms -- 9'-6" to structure, allowing 12' height for continuous lighting fixture at platform edge. See IV C2.2 for overhead clearance limitations where low ceiling over platform steps up to high ceiling over track.
3. Structure over busway -- 13'-6" above roadway. See IV C2.3.
4. Miscellaneous pedestrian circulation areas: for short distances (under beams, etc.) -- 7'-6", preferred minimum 8'-0".

PLATFORM AREAS - Design Criteria



Notes:

1) All clearances are for tangent track. Horizontal clearances increase on curves.

2) Dimensions shown apply to all lines unless otherwise noted.

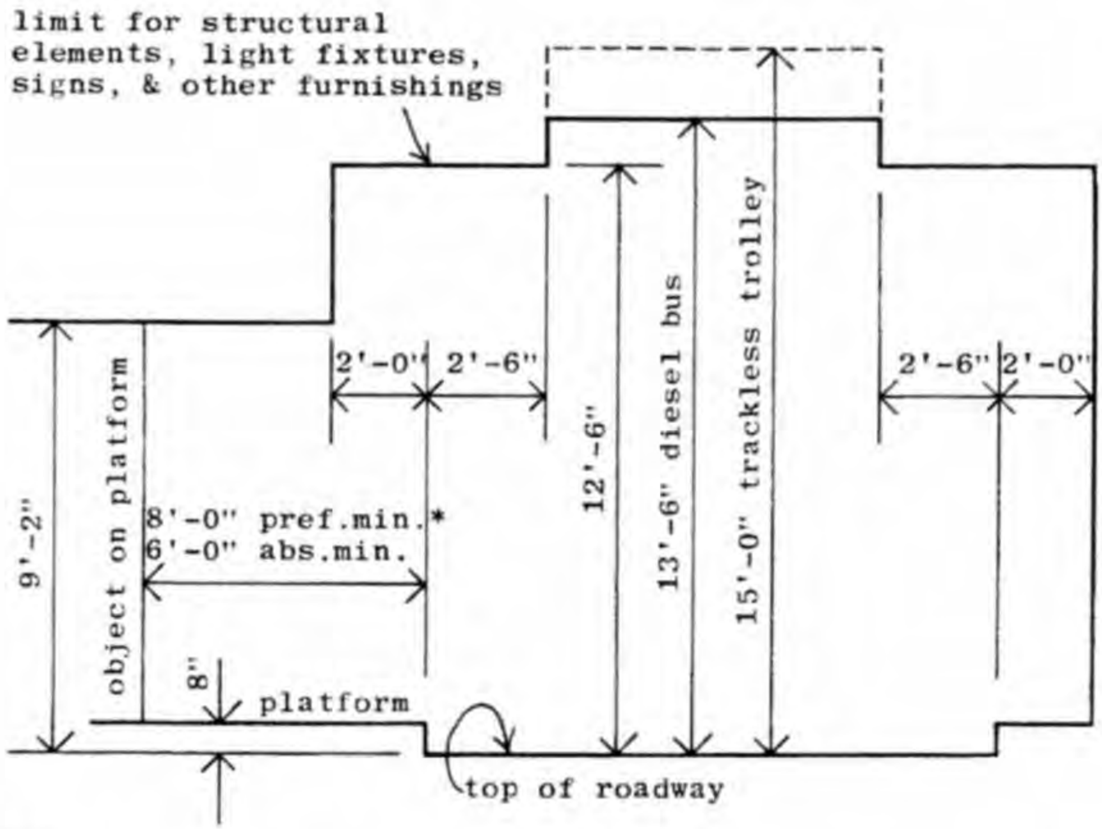
3) At all locations where walls or furnishings such as signs and lights, are less than 8'-0" from track centerline, niches 1'-0" deep, 2'-0" wide, and 7'-0" high will be provided at least 20'-0" on center.

4) At locations where a continuous walkway is provided across the track from the platform, furnishings such as signs and lights attached to the wall must be at least 6'-6" from track center line, and must be at least 7'-0" above the surface of the walkway. Maximum height of walkway above top of rail is 1'-0".

5) Vertical clearances shown provide minimum of 8'-6" headroom over platform area.

PLATFORM AREAS - Clearance Requirements - Red, Orange, Blue & Green Lines

Key:
R = Red Line
O = Orange Line
B = Blue Line
G = Green Line



Notes:

*Bus stop signs may be located within this area, but sign panel should be at least 2'-0" from curb, and 7'-0" above platform.

PLATFORM AREAS - Clearance Requirements - Busways

Basic Objectives

Vertical circulation elements consist of stairs, escalators, ramps and elevators.

a. Stairs at entrances should provide clear and direct access to the fare collection area, with a minimum of unused alcoves and hidden corners, and decision points.

b. Stairs and escalators should be sized and located for expected traffic volumes and directions. Access to paid and unpaid areas should be clearly separated, with no possibility of cross connection within a station. It should be possible to correct a wrong turn, or to change directions between inbound and outbound, without crossing the paid-unpaid boundary.

c. Existing stairs and passageways should be walled off, or removed, if no longer required and if the basic clarity of circulation is thereby improved.

d. Existing stairs should be reconditioned and new treads and handrails installed.

e. Elevators will be installed at selected locations to meet the requirements for handicapped accessibility. When possible ramps will be used instead of elevators.

f. See IVE-2 for emergency exit criteria applicable to all stations.

VERTICAL CIRCULATION

Location

A minimum of two stairs is required to serve each platform or major public space. However in some stations one stair may be an emergency stair, or may be waived in favor of other means of egress, as determined by the Authority.

Design Criteria

a. Maximum capacity for a stair is 20 persons per foot of width per minute and absolute maximum in emergencies is 25. Station occupancy loads and allowable times for emptying the station will be furnished by the Authority.

b. Design capacity for a stair is 15 persons per foot of width per minute.

c. A pedestrian lane has a minimum clear width of 1'-10" (22").

Landings

Landings shall have a minimum length of 4'-6", and width equal to the stair.

Minimum Run-off (clear space) at tops and bottoms of stairs:

a. To a solid obstruction: Width x 1.7

b. To edge of queue space: 10'

c. To another stair or escalator: 30'

Note: run-off for stair and escalator in same well is the combined width x 1.7

Width and Headroom

a. Minimum width for new stairs: 6'-0". Handrails may encroach on each side a maximum of 3 1/2".

b. All stairs should have a minimum of 7'-0" clear headroom.

Treads and Risers

a. All risers in any stair must have a uniform height.

b. The minimum and maximum riser and tread shall be:

Minimum riser 6"	Maximum tread 12 1/2"
Maximum riser 7 1/2"	Minimum tread 10"

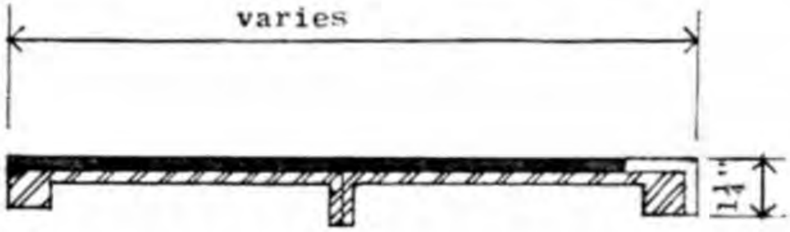
c. Treads and risers shall be proportioned so that the sum of two risers and one tread is not less than 24, not more than 25. Treads shall be measured from face to face of riser. Projecting nosings are not allowed.

d. Long flights must be subdivided, with intermediate landings, so that no flight has a greater rise than 8'-0". Stairs without landings must not have more than 15 risers. Short flights must have at least 3 risers.

Treads on stairs exposed to the weather should be slightly pitched, for self-draining.

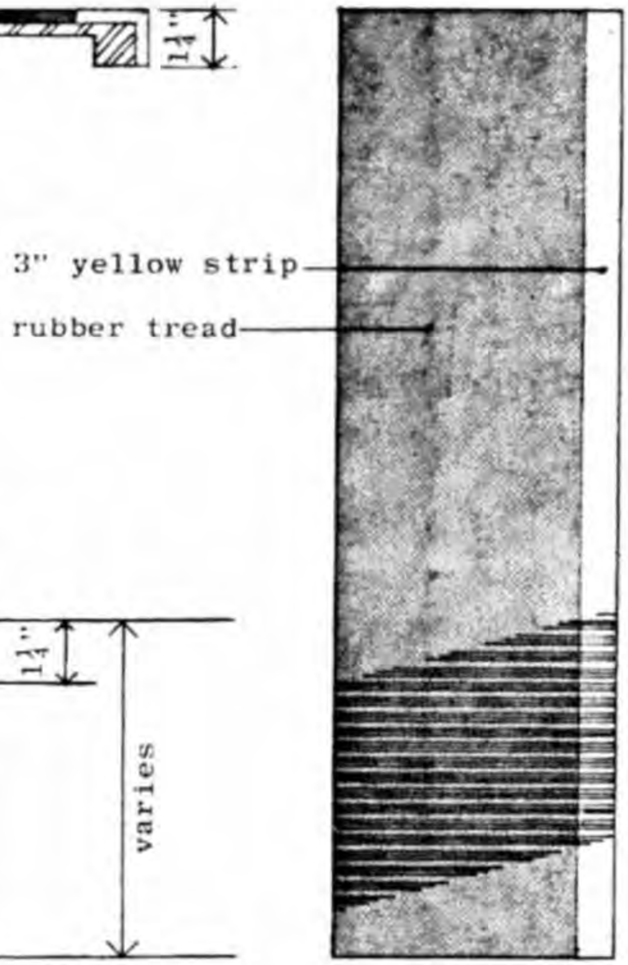
Where open riser stairs are used to permit through-visibility, treads must overlap each other at least 3". Such stairs can be used only when there is an optional route with closed riser stairs (or ramps) available.

STAIRS

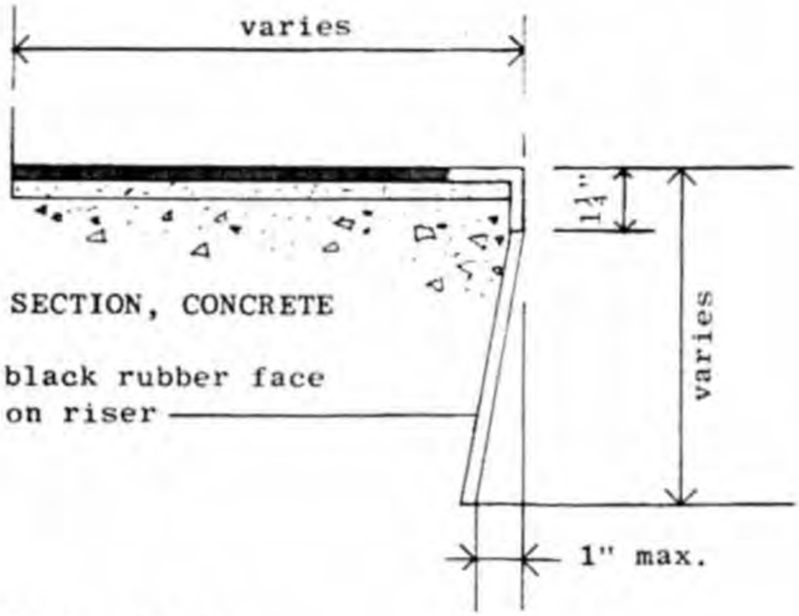


SECTION, STEEL

steel tread, as required
flange must be shallow
enough to be hidden
rubber nosing



1½"=1'-0"
PLAN



SECTION, CONCRETE

Stair Tread

Rubber Stair Treads: "Rub-Bub" Heavy Duty Safety Step Plates, consisting of rubber surfacing chemically and mechanically molded to a stainless steel backing plate with double ribbed "Dri-Foot" tread design, as manufactured by Ace Rubber Products, Inc.,or equal approved by the Authority. Integral colored rubber strip in each tread shall be bright safety yellow color of dimension and position shown.

STAIRS scale 3" = 1'-0"

Handrails

a. Height: 2'-9", measured vertically from the top of the tread at the nosing, to the top of the handrail. (3'-0" at landings and at top and bottom of runs).

b. Handrails may extend a maximum of 3 1/2" into required stair width.

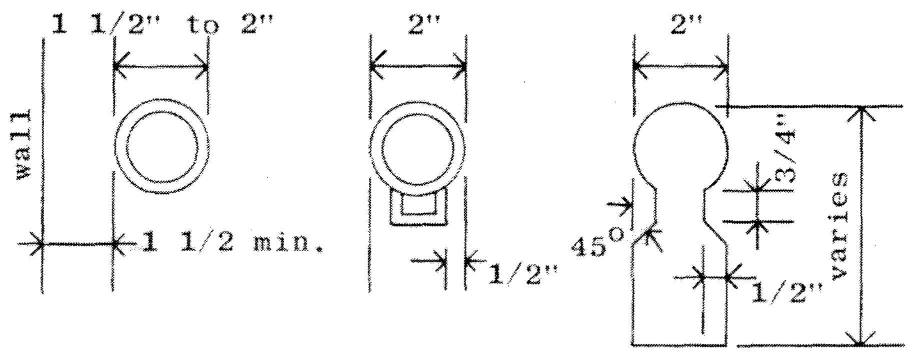
c. At landings of 6' length and less, the handrails, both wall and post mounted, should continue across the landing without break, unless the swing of a close-off gate requires that a break be made.

d. Wherever support conditions allow, each wall-mounted handrail should extend horizontally at a height of 3'-0" for a distance of 1'-6", at both top and bottom of runs. The purpose is to afford a firm grip before the ascent or descent begins.

e. Handrails must be provided on both sides of all public stairs. Center handrails must be provided at all stairs wider than 7'-4", so that such stairs are divided into lanes between handrails of 7'-4" maximum width and 4'-0" minimum width.

f. The sides of all stairs must be protected below handrail height. Steel pickets at 6" spacing may be used. Pipe rails, if used, should have an intermediate rail 1'-7" above the top of tread at the nosing, and a maximum opening between rails, or between rails and curb, of 10".

g. Handrails must be shaped and sized so that they afford a firm grip to all users. The following designs are acceptable:



h. The handrail must be stainless steel or hardwood. The supporting structure may be stainless steel or black painted galvanized steel. All pipe rail joints must be welded and ground smooth.

STAIRS

Design Criteria

a. Location and capacity: Up escalators should be used where the rise is 12' or more. Down escalators should be used where the rise is 24' or more. Maximum capacity for an escalator of 4'-0" nominal tread width and speed of 120' per minute is 135 persons per minute. *The absolute maximum in emergencies for a standing escalator is 90 persons per minute. Use 100 persons per minute for design capacity.

b. Dimensions: 4'-0" nominal tread width, required in all new installations. Overall width varies 5'-8" to 6'-0".
Slope 30°
Minimum clear headroom 7'-0"

c. Minimum Run-off (clear space) at tops and bottoms of escalators:

1. To a solid obstruction: 15'
2. To edge of queue space: 10'
3. To another escalator or stair: 30'

d. Moving sidewalks shall conform with the above requirements (maximum slope 15°).

e. Exposed metal (deckplates, interior panels, newels, etc.) shall be #4 finish stainless steel. When exterior paneling is required (i.e. when an escalator is open on one or both sides), it shall be stainless steel to match the other parts, and be of flush butt-jointed construction, with no exposed fasteners, and no battens or joint covers. Paneling should be adequately reinforced to prevent oil-canning, and noise-making when struck. Deck plates should meet the wall in a flush, gasketed detail to prevent dirt infiltration into the machinery. Stainless steel anti-slide knobs are required on the deckplates.

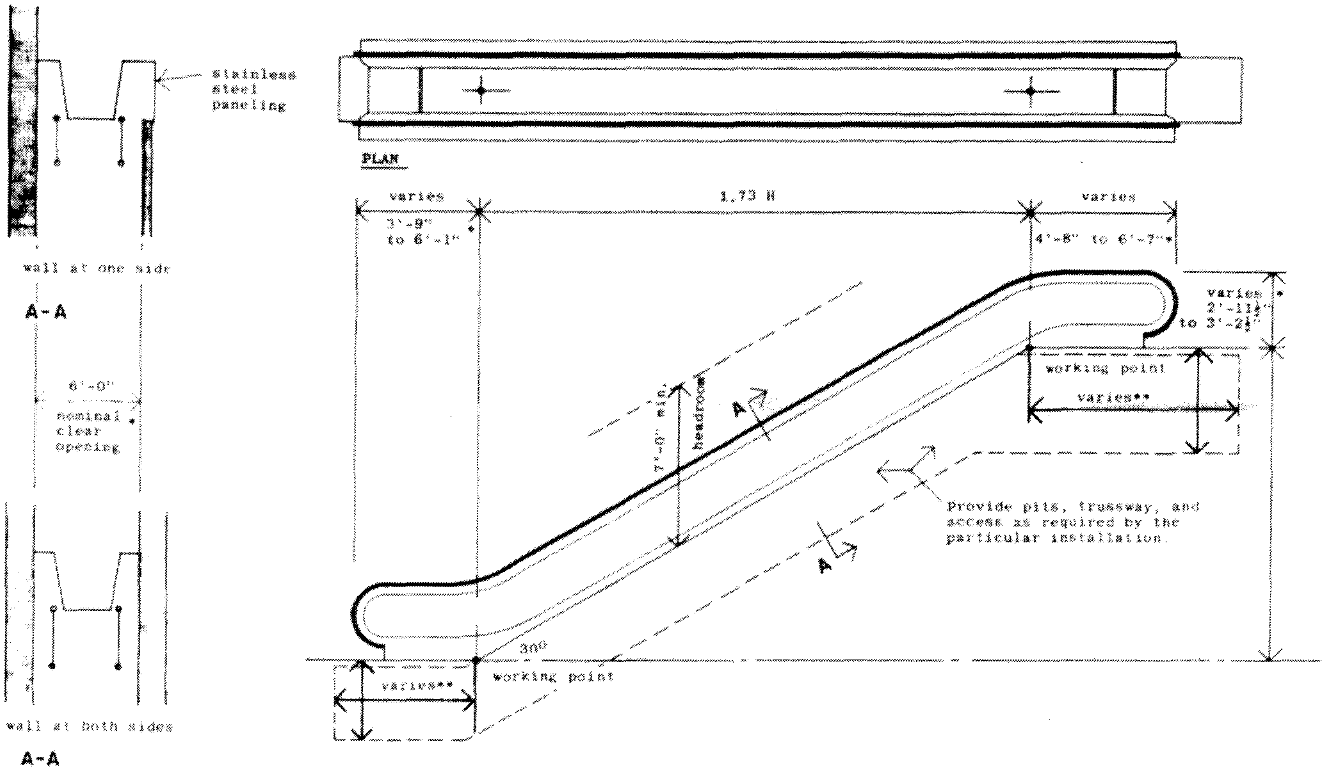
f. Ventilation for machinery, and access for periodic maintenance must be provided, preferable from a room beneath the escalator. Floor pits will generally require a sump pump, and floor access doors must be designed to receive whatever floor material is used.

g. All escalators will be the reversible type. Escalators shall be able to be operated down at a slower speed than up. Control switches should be located in a room beneath the escalator, or in another service room. The Authority has a standard specification covering all functional aspects of the escalator.

h. Emergency shut-off switches are required at the head and base of each escalator. Typically they will be recessed in the wall construction. See sheet C 4.3 for this switch.

i. See Part V: Graphics, for signing at escalators.

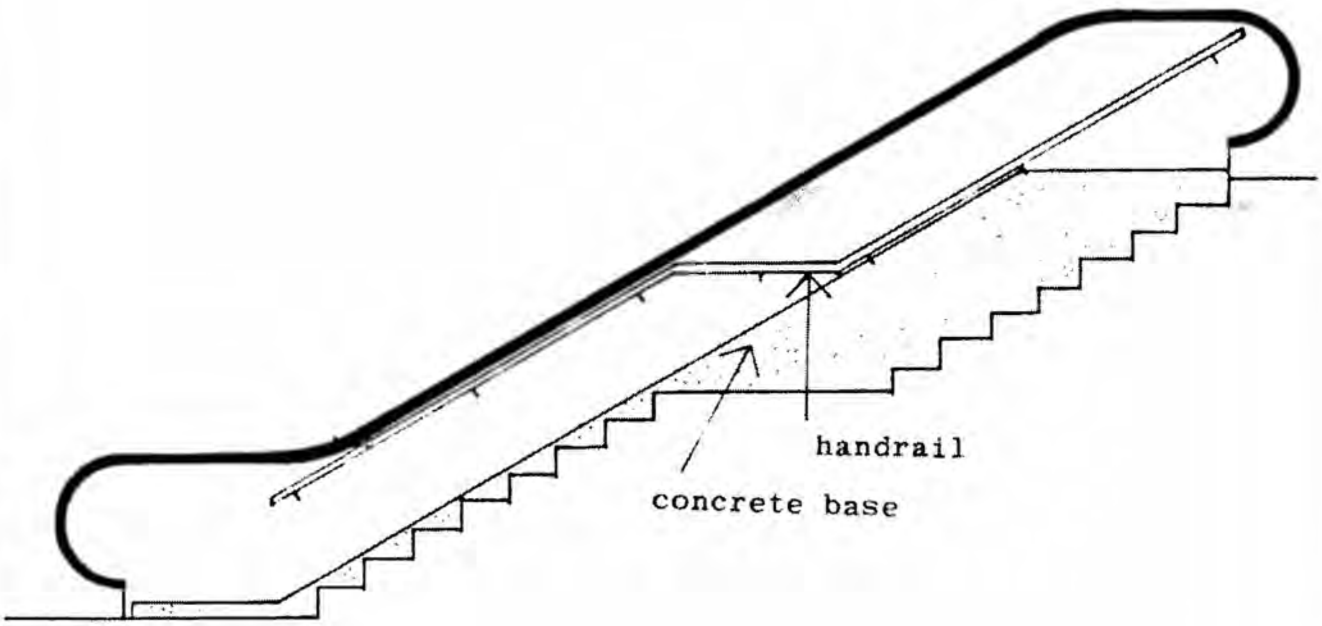
ESCALATORS



*Consult manufacturers catalogues.

**Escalator pits must be designed to fit any currently available escalator. The supporting beams will be located in the field after a particular machine has been obtained.

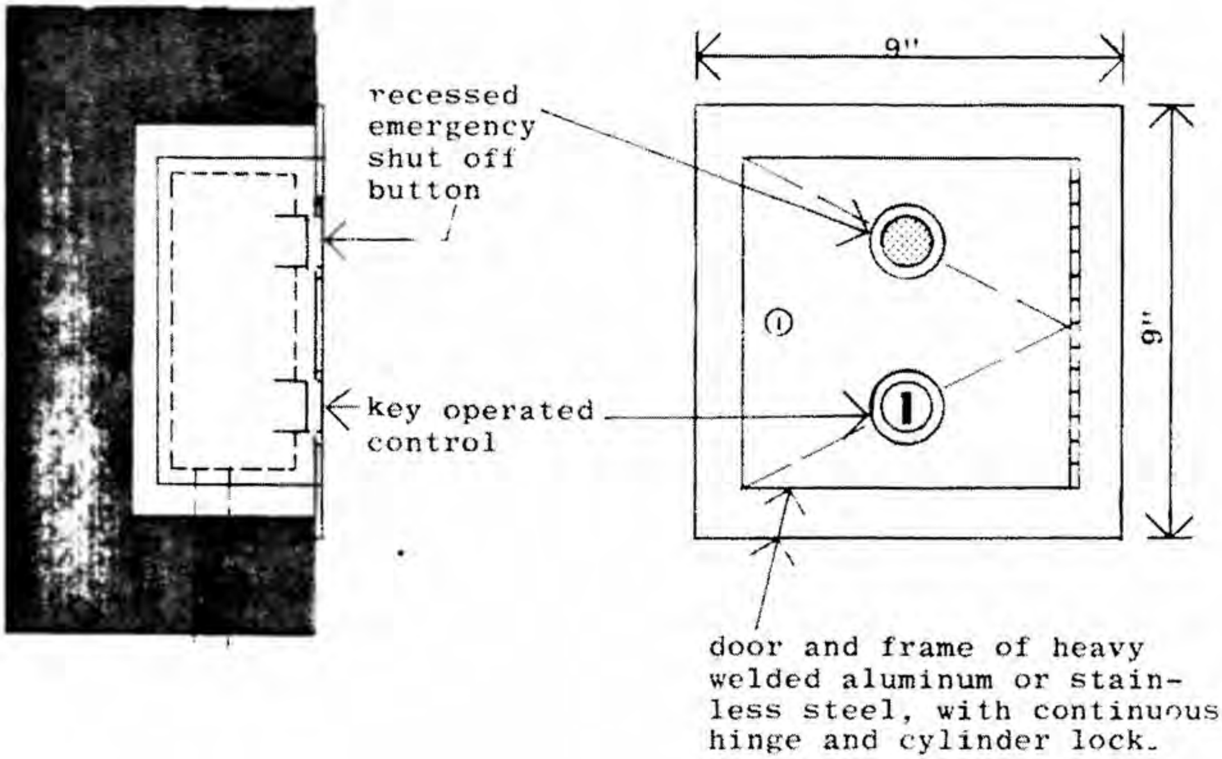
ESCALATORS



Stair - Escalator Relationship

Where stairs occur along side an escalator, the rise/run of the stair should be set to closely match the 30°escalator slope, and the stair itself so located that the handrail remains below the escalator deckplate.

ESCALATORS



Emergency shut-off switch

Recess box in wall, at both top and bottom of escalator, maximum of 10' -0" from the escalator, and at a maximum of 5'-0" above the floor.

See Part V: Graphics, for required sign.

ESCALATORS

Escalator Control Criteria

The following criteria will apply to all new escalators used in Authority facilities. In addition, the design will meet the requirements of the "State Building Code", and planning criteria shown elsewhere in the Manual (see I-Guideline & Principles, other parts of IV Components, and X Site Planning & New Stations)

1) All escalators will be reversible and will be operable in both directions at a speed of 90 and 120 feet per minute.

2) Control for the direction and speed of escalators will be in locked cabinets, duplicated at each end of the escalator, and located to facilitate supervision of the escalator when a change of direction is made. (Authority personnel could block persons from entering the escalator, then reverse when clear.)

3) Emergency stop buttons for public use will be located at each end of the escalator. They should be placed to prevent accidental actuation by the users of the escalator.

4) Escalator stop controls, and pilot lights indicating a stopped escalator, will be located at the primary collection booth and other locations designated by the Authority. Capability of a tie-in to the control center will be provided.

5) Escalator's feeding <u>into</u> a subway station platform or lobby should be tied-into the fire and smoke detection and other emergency alarm system's as required, so that they will be stopped when such systems are actuated. Escalators <u>are</u> acceptable means of emergency egress from a station.

6) At locations where locked doors or gates close-off access from an escalator, the control of the escalator must be interlocked with the locking system for the doors or gates to prevent operation of the escalator in a direction which could trap people.

7) At escalator's which are intended for reversible operation as a normal routine (say up in the morning rush and down in the evening), back-lit directional signs (See V Graphics) with latent display capability will be tied-into the escalator control.

8) Acceptance tests of completed escalator installations will include testing of the escalator in both directions of travel, at both speeds, and tests of all related control devices, interlocks, signs, etc.

DESIGN CRITERIA

a) Elevators are used only when required to meet the requirement for handicapped accessibility. Normally they are located to connect a free area with a free area, or to connect a paid area with a paid area. In special situations a double door elevator may serve both these functions (see Oak Grove Station). In existing stations it may be necessary to connect a paid and free area, which requires special pass-reading equipment at the entry in the free area.

b) It is desirable to locate elevators so that they can be observed directly by station personnel or by closed circuit television. Eelvators shall not be located where they would interfere with the normal pedestrian flow within the station.

c) Doors to elevators in new stations shall provide a clear opening of 3'-0" minimum width. Doors to elevators in stations which are being altered, remodeled, or undergoing a change of use shall provide a clear opening of 2'-8" minimum width, only if 3'-0" is not possible.

d) Cab size: minimum interior dimensions of the elevator cab measured wall to wall (excluding the rub rail) shall be 4'-0" wide by 4'-6" deep minimum in new construction; and 4'-0" x 4'-0" minimum in existing construction.

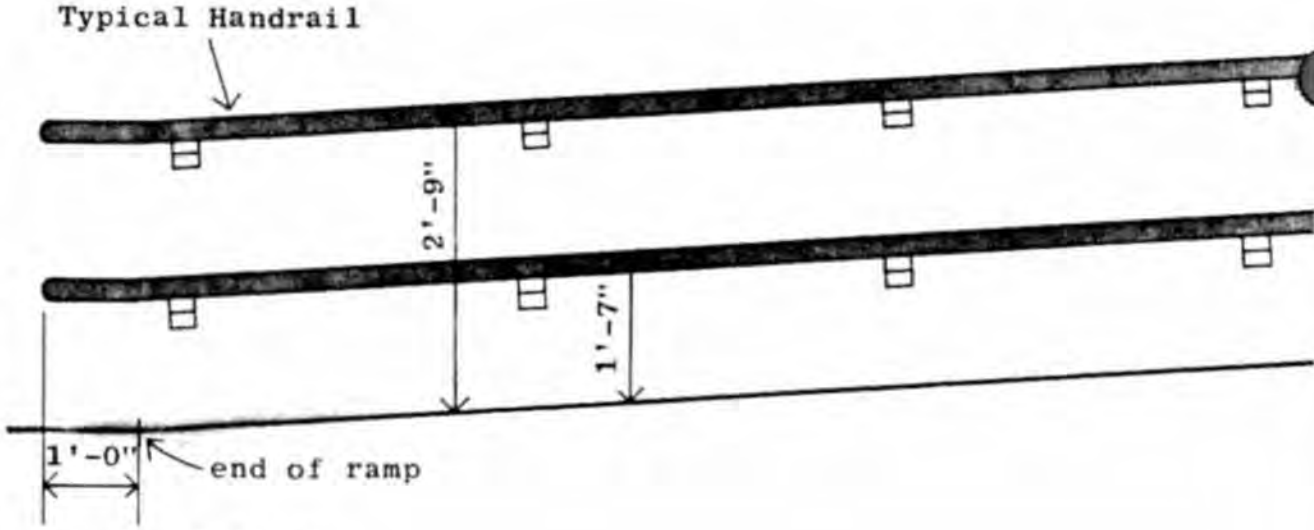
e) Controls (including emergency telephone) of automatic elevators shall be located no higher than 5'-0" and no lower than 3'-2" above the floor of the elevator. Numbers and letters shall be large raised or recessed for use by visually handicapped.

f) All controls for the elevators shall have large raised or recessed numbers/letters and light on dark background for use by the visually handicapped; and there shall be no ashtrays or other obstacles placed directly below or above. Audible signals shall be provided and the "up" signal shall be different from the "down" signal. Floor numbers shall be provided at each level on the elevator entrance jamb located on the right side when exiting and shall be raised or recessed and light on dark background.

g) Rub rails shall be secured to all walls of the cab and located 3'-0" above the cab floor.

h) Doors shall have a sensitive safety edge. Doors shall have a sensing device to prevent closing while entering or exiting. Doors shall be set to close in not less than six (6) seconds.

ELEVATORS



Design Criteria

1. Passages:

   a. 10' preferred minimum width in new construction, but in no case less than that of stairs served. Absolute minimum width 6'-0".

2. Ramps:

   a. Should be used at small changes in level in preference to short runs of stairs, and for long inclines where the desired slope is attainable without resort to stairs.

   b. Provide same minimum run-offs as with stairs. Minimum clear width is 4'-0"

   c. Absolute maximum slope 1:12 (8.33%)

   d. At slopes steeper than 1:20 wall mounted handrails should be provided, on both sides of the ramp.

   e. Ramps steeper than 1:20 require landing of 5'-0" min. length every 34' of run.

   f. Maximum capacity of passages and ramps is 25 persons per foot of width per minute, and absolute maximum in emergencies is 30.

   g. Design capacity is 20 persons per foot of width per minute.

RAMPS AND PASSAGES

Fence components include low and high fences, and guard rails. Fences consist of a horizontal rail, and either balusters or infill panels. Guard rails consist of only a horizontal rail, and posts if required.

a. Fences are used to separate paid and unpaid areas, and to prevent accidents where a change in level occurs. When separating paid and unpaid areas, low fences may be used only where continuous supervision by Authority personnel is available.

b. Guard rails are used to control circulation patterns within the paid or unpaid areas, to prevent track crossing, and to prevent accidental trepass onto danger areas. They are a less emphatic barrier than fences, and are intended simply to serve notice of forbidden access, not to physically prevent it.

FENCE - Description

a. The following fence constructions are approved by use, both in low (3'-2") and high (6'-10" or to ceiling) types.

   1. Steel picket

   2. Others subject to approval by Authority

b. Low fencing at or near the fare collection line should incorporate a 9" deep band of stainless steel, set at the same height as the matching band on the turnstiles. Nearby high fencing, if divided horizontally, should have a similar 9" band, painted with the fence frame, and set at the same 3'-2" height.

c. One type of fence should be used consistently throughout a station, or area of a station. The Authority will consider other fence constructions provided that the requirements of strength, durability, and maintainability are adequately met, and that the fence material is suitable in scale and transparency. Many spaces within the subway are small, and contorted in plan; therefore additional screens (fencing) set within these spaces should detract as little as possible from clarity of circulation, and ease of maintenance and surveillance.

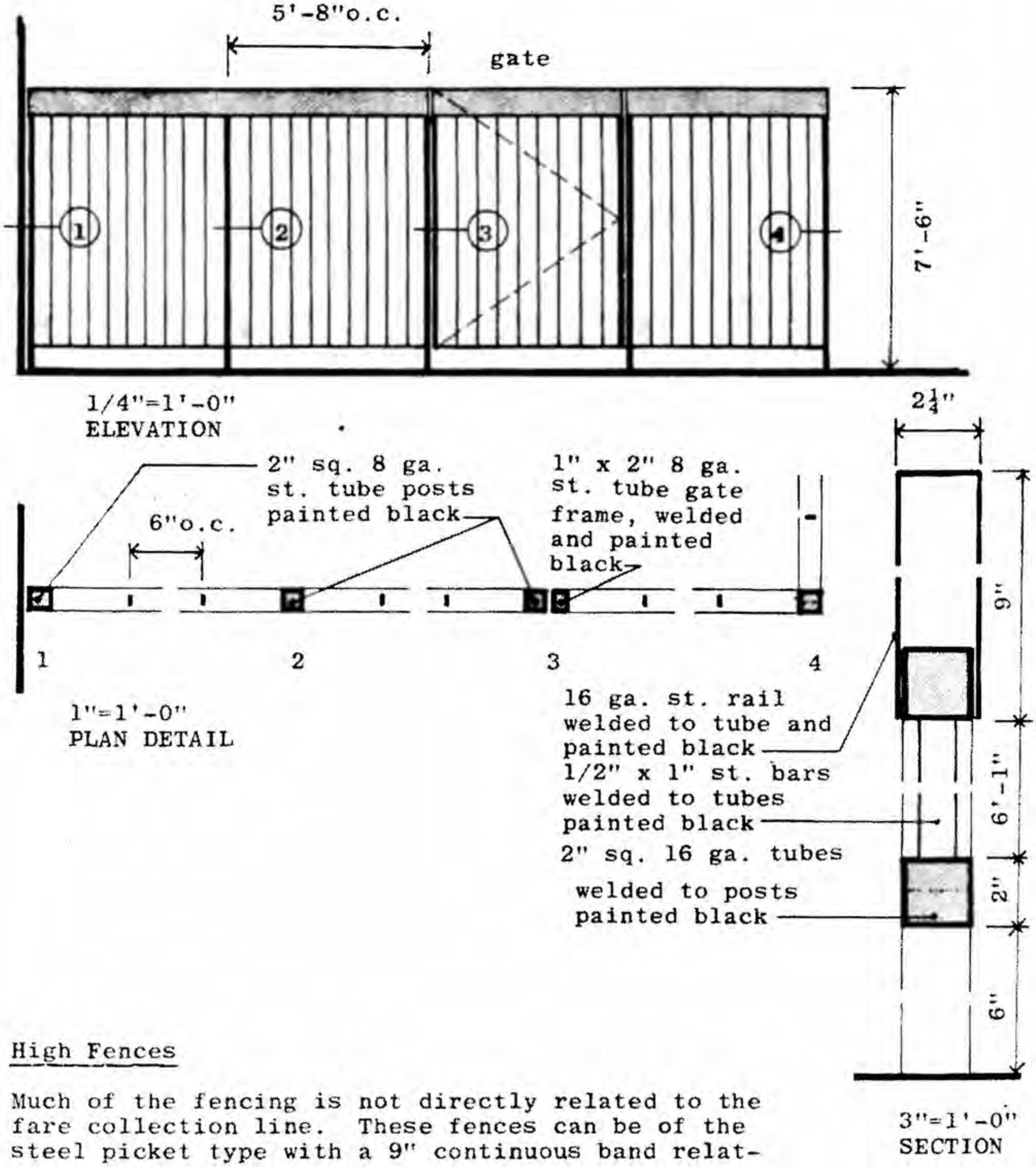
d. Present fencing is typically of the picket type. In many places, it can be converted by installing a 9" metal band, as shown on Sheet C-6.3.

e. Parapets or external railings of overhead walkways, balconies, or open parking garages should be 3'-0" high with minimum opening of 10".

f. Where overhead walkways or mezzanine structures cross tracks, barriers or fences must be at least 7'-0" high. Minimum opening is 6".

g. Where smoke barriers are required, see IV E1.2, wire glass may be used. Maximum size of individual glazing elements is 9 sq. ft.

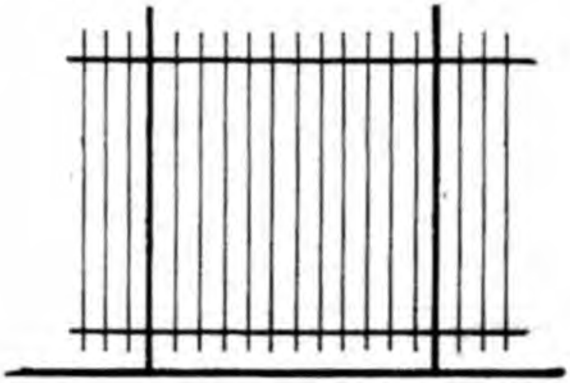
FENCE CONSTRUCTION



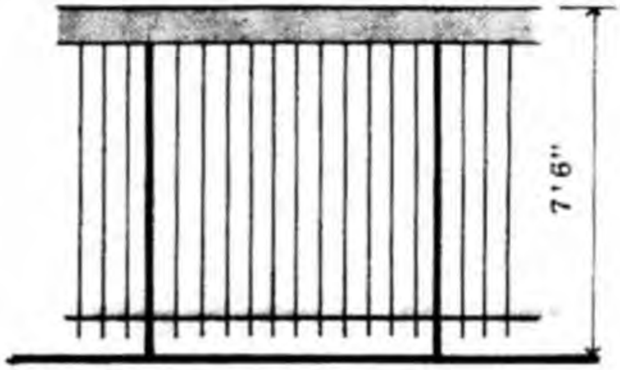
High Fences

Much of the fencing is not directly related to the fare collection line. These fences can be of the steel picket type with a 9" continuous band relating to established heights.

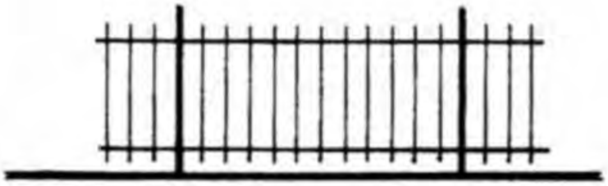
FENCE - Suggested detail



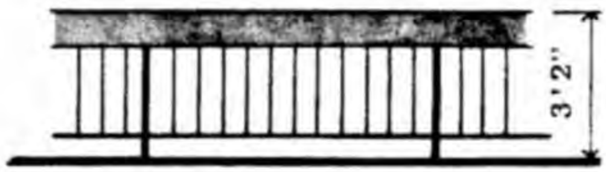
EXISTING HIGH FENCE



MODIFIED HIGH FENCE



EXISTING LOW FENCE

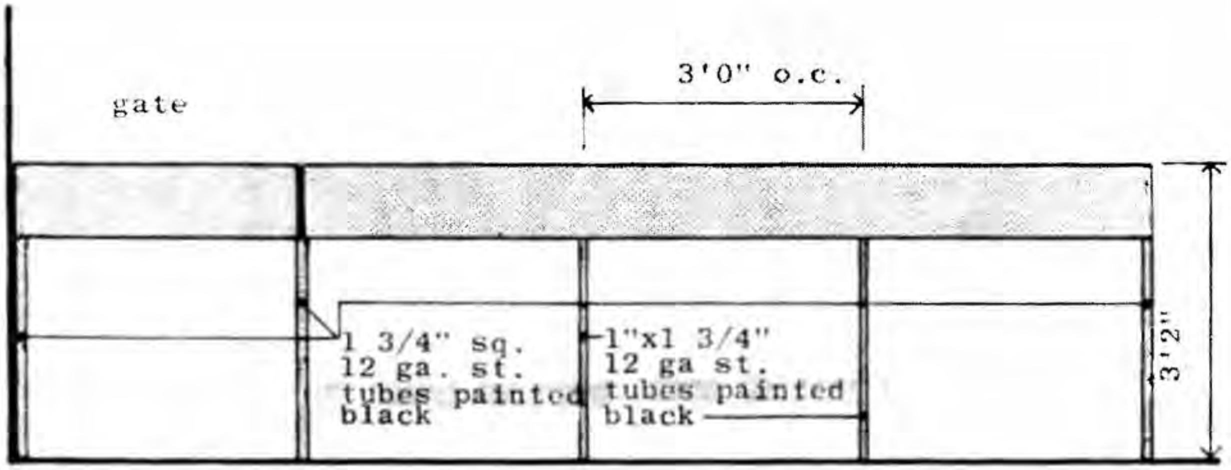


MODIFIED LOW FENCE

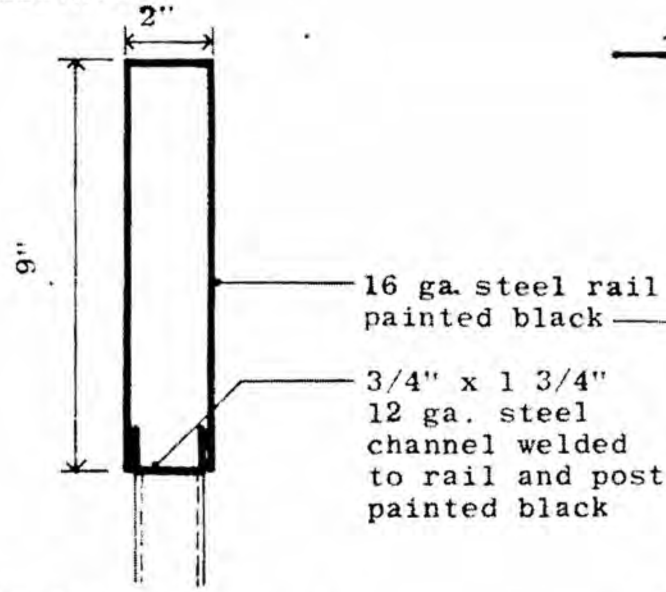
Existing Picket Fence Modification

Where an extensive amount of wrought iron fence exists, this may be simply painted, or modified and relocated as shown in schematic station design.

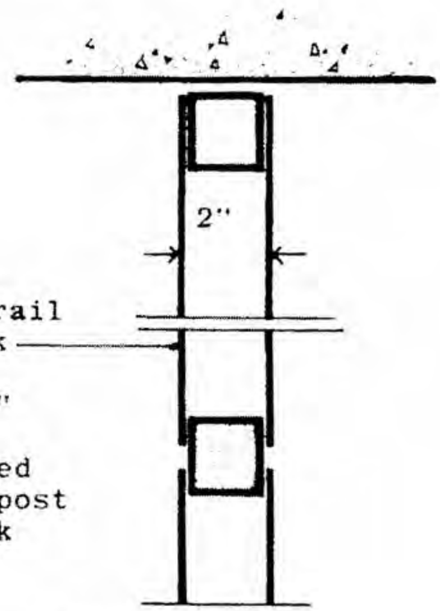
FENCE   scale 1/4" = 1'-0"



1/2"=1'-0"
ELEVATION



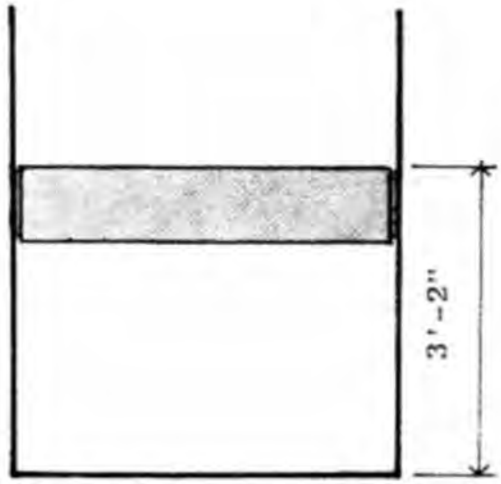
3"=1'-0"
PLAN SECTION @ GATE



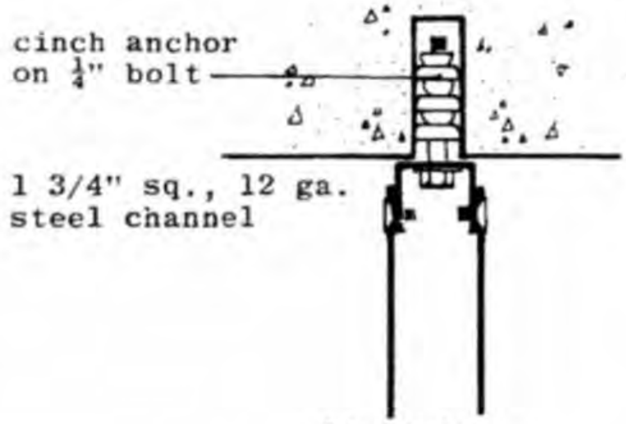
3"=1'-0"
SECTION

Guard rails are used to separate low level platforms, closures beneath stairs, restricted areas.

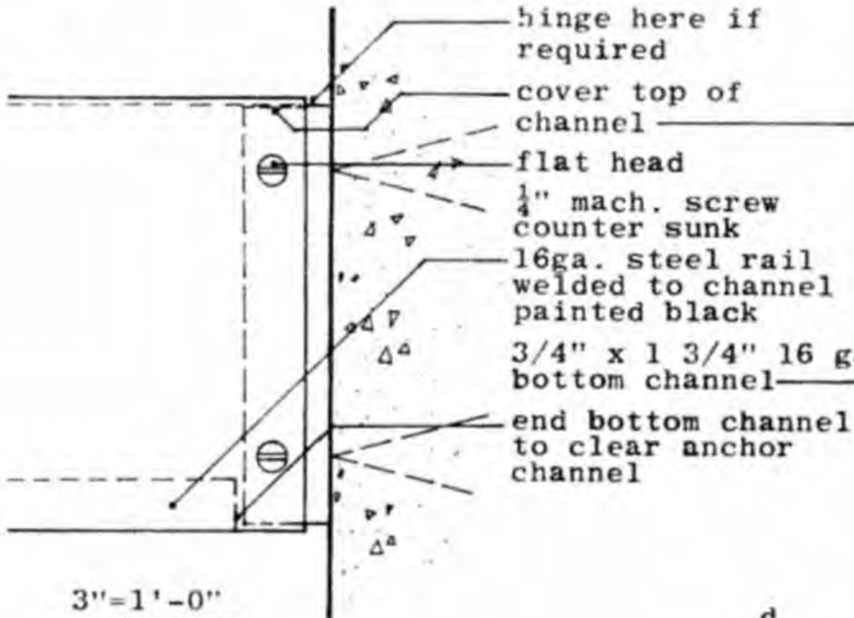
GUARD RAILS - Suggested detail



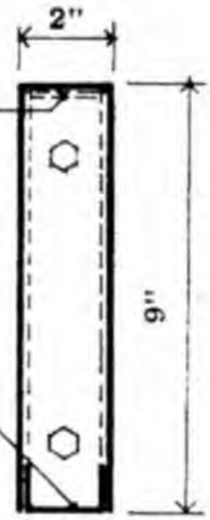
1/2"=1'-0"
a. ELEVATION



3'=1'-0"
b. PLAN



3"=1'-0"
c. ELEVATION



3"=1'-0"
d. SECTION

Guard rails Between Walls

a. Between walls or columns

b. Section at wall

c. Elevation at wall

d. Cross section

GUARD RAILS - suggested detail

Public Convenience Facilities

This section covers all components that are generally considered to be "public convenience facilities". There are essentially two types of facilities:

a. Station furnishings which are provided and maintained by the Authority.

b. Commercial facilities, which may or may not be provided by the Authority, but which are operated and maintained by a concessionaire.

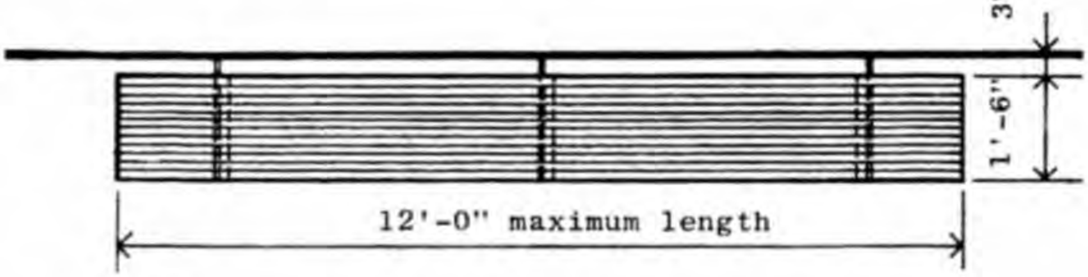
Station furnishings will be provided at every station for the use of waiting passengers. Commercial facilities will be located within stations only after market analysis by the Authority.

Commercial facilities should be planned adjacent to the traffic flow, but with sufficient space for people to move out of active circulation. They should never be permitted to interfere with the normal flow of circulation even at rush hour, nor with information graphics, and should never occur on platforms in positions where they might interfere with circulation to and from trains.

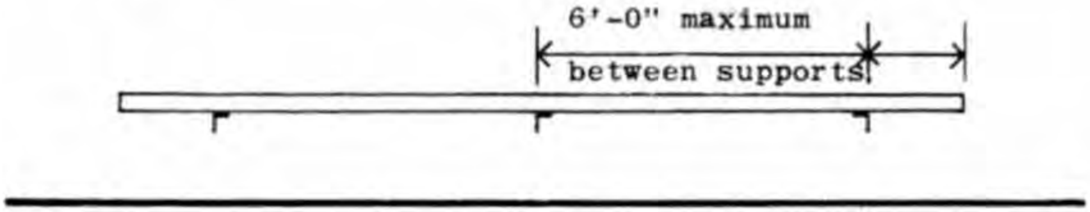
Platform components have been selected and/or designed to relate vertically to other elements, especially on platform sidewalls, and where such components occur, the design of platform sidewalls (e.g. the location of the station identity band) should be modified to accomodate them.

Refer to Part IX: Service Facilities, for public toilets.

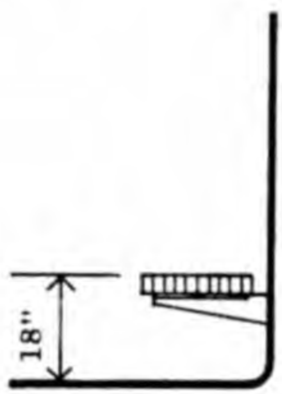
EXPLANATION



PLAN



FRONT ELEVATION



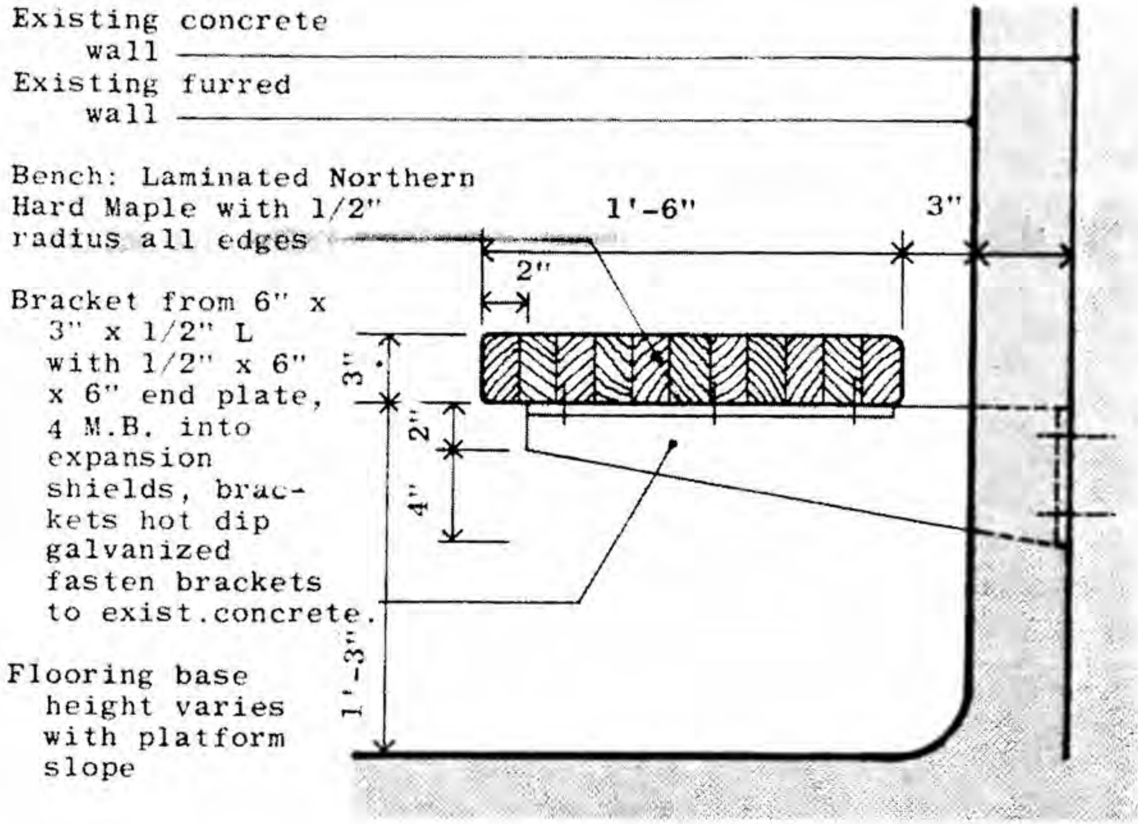
END ELEVATION

Wall-mounted

Wall-mounted laminated wood benches are the preferred type. Cantilever support facilitates cleaning, but requires secure anchorage into a concrete wall.

Benches should be located, in general, only at platform level, and concentrated where trains normally stop during all hours.

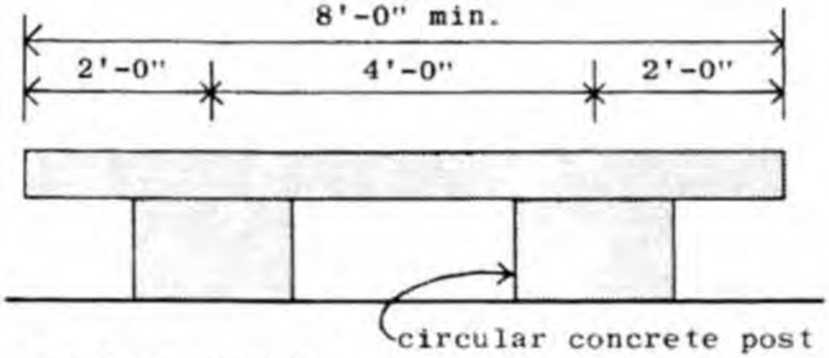
BENCHES



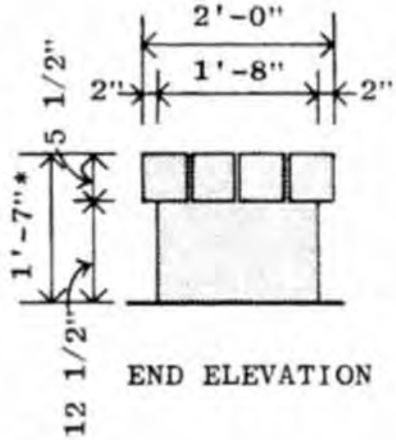
Installation Detail

natural finish, heavy duty varnish

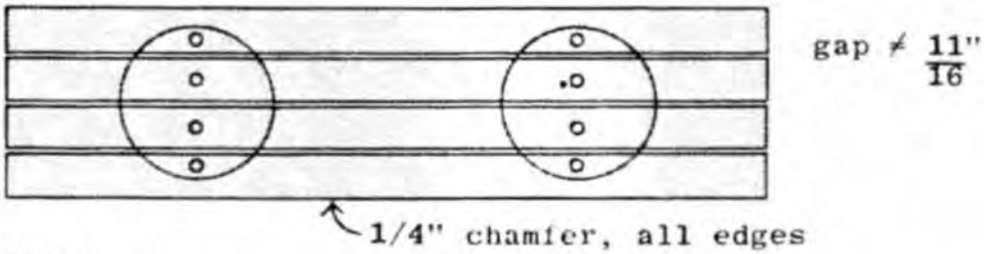
BENCHES   scale 1 1/2" = 1'-0"



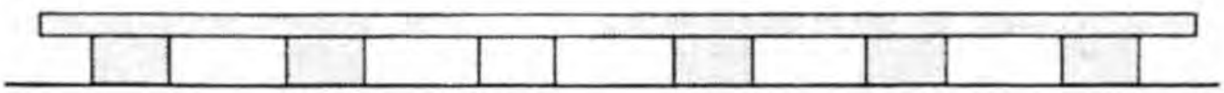
FRONT ELEVATION



END ELEVATION



PLAN



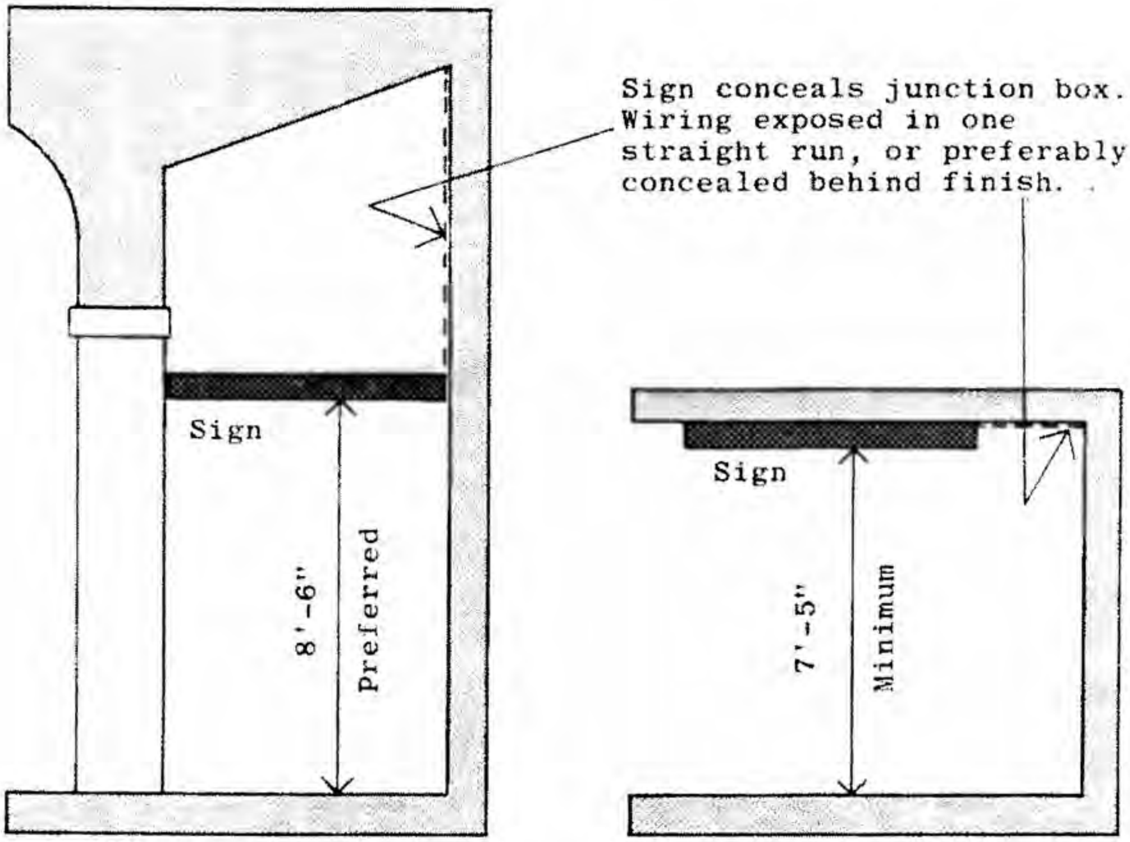
ELEVATION 1/4" = 1'-0"

Heavy Timber Bench

Used in areas exposed to rainfall. When long continuous bench is used, timber joints should be staggered.

*On sloping sites, or where many benches are available, height may be varied.

BENCHES Scale 1/2" = 1'-0"
Suggested detail



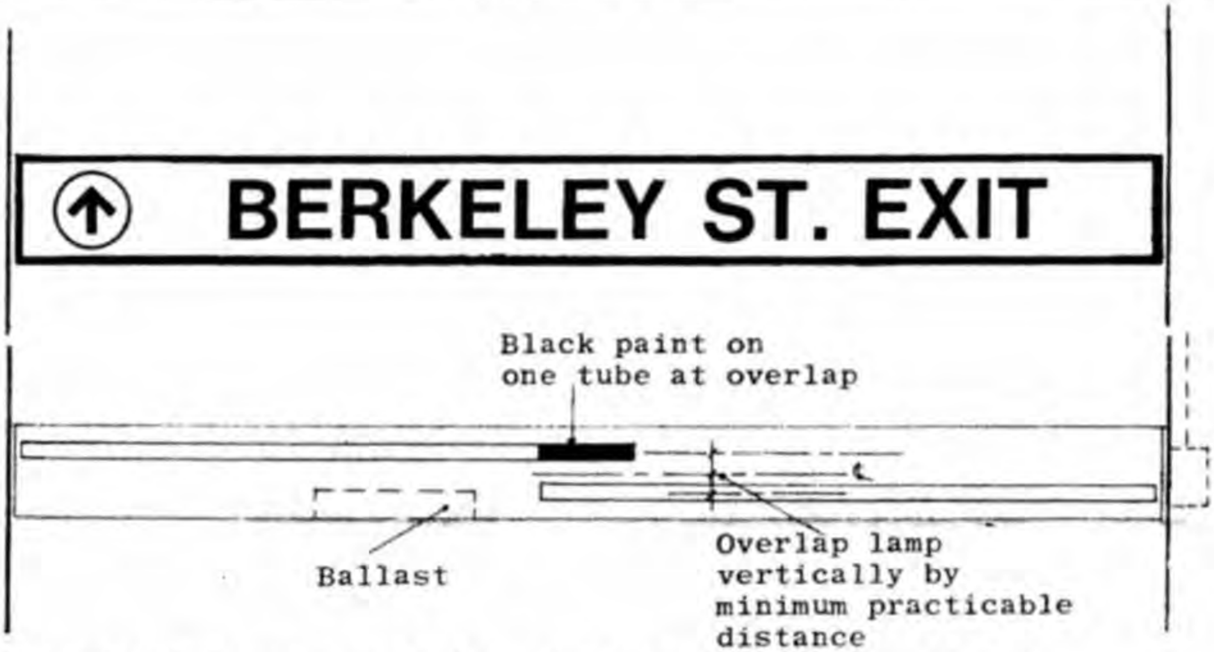
At Platform Area

At low headroom area

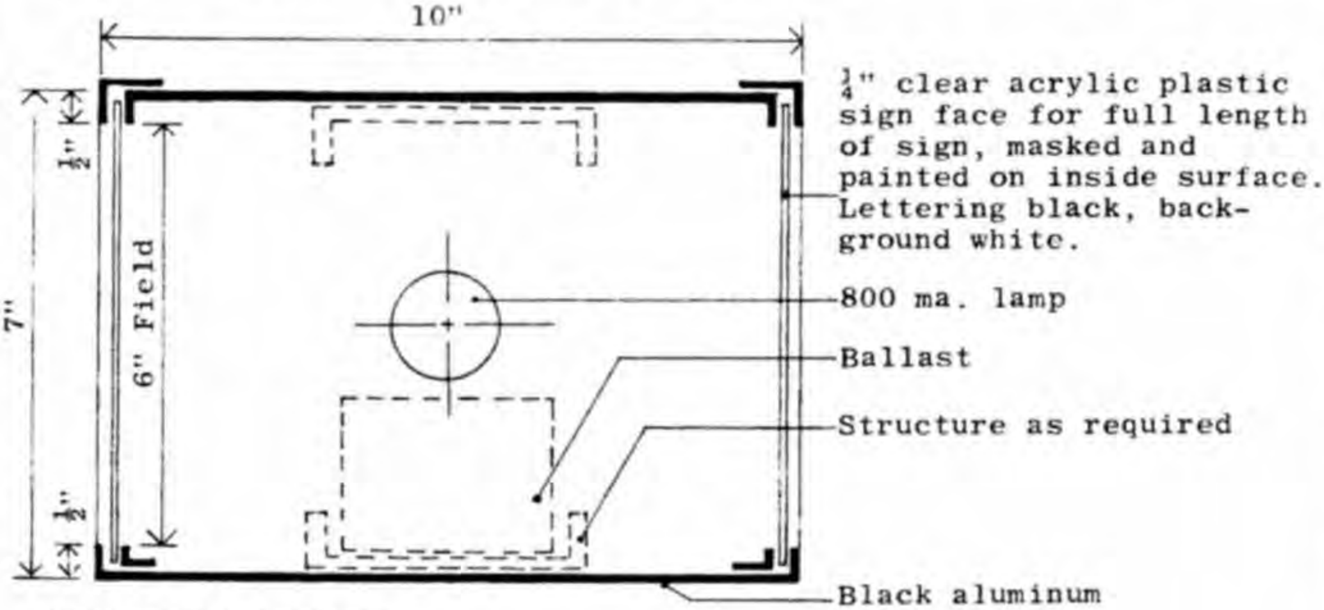
Signs generally give directions to exits, or to connections with other lines. In some cases signs will have two sets of copy to be turned on and off as desired circulation may vary during the day. For such signs, switch wiring should be concealed, with key-operated switches located in service rooms.

For colors and lettering, see Part V, Graphics.

INTERNALLY-ILLUMINATED SIGNS
Station Interior



Longitudinal Section - at lapped lamps, where sign length does not accommodate standard lamp lengths.

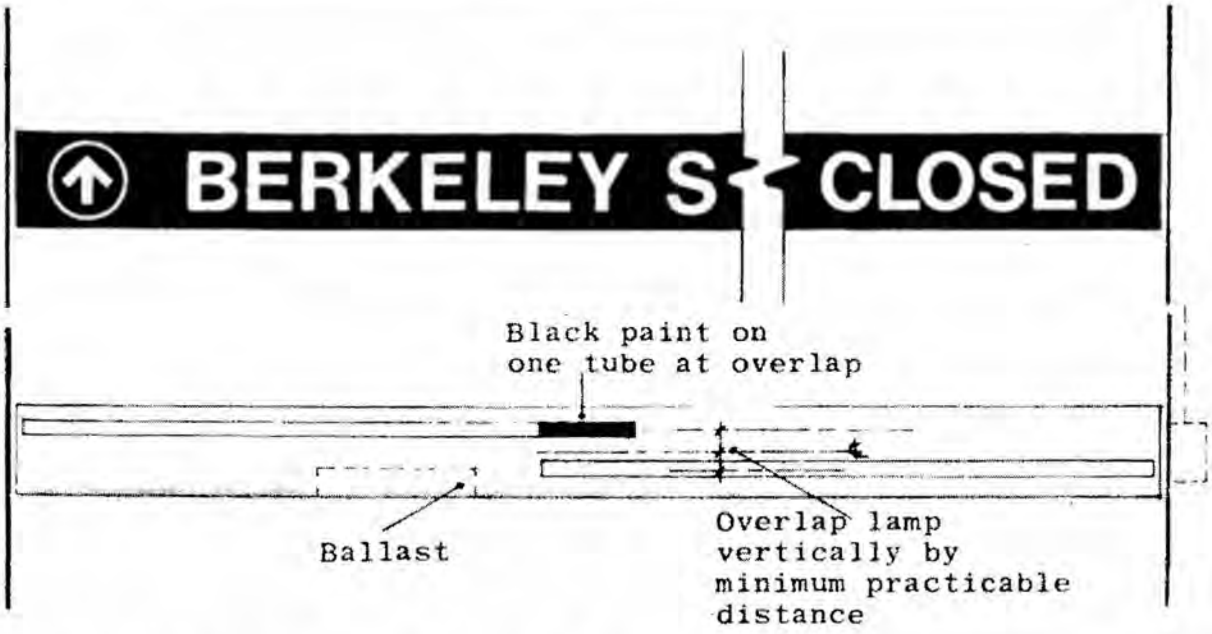


Transverse Section

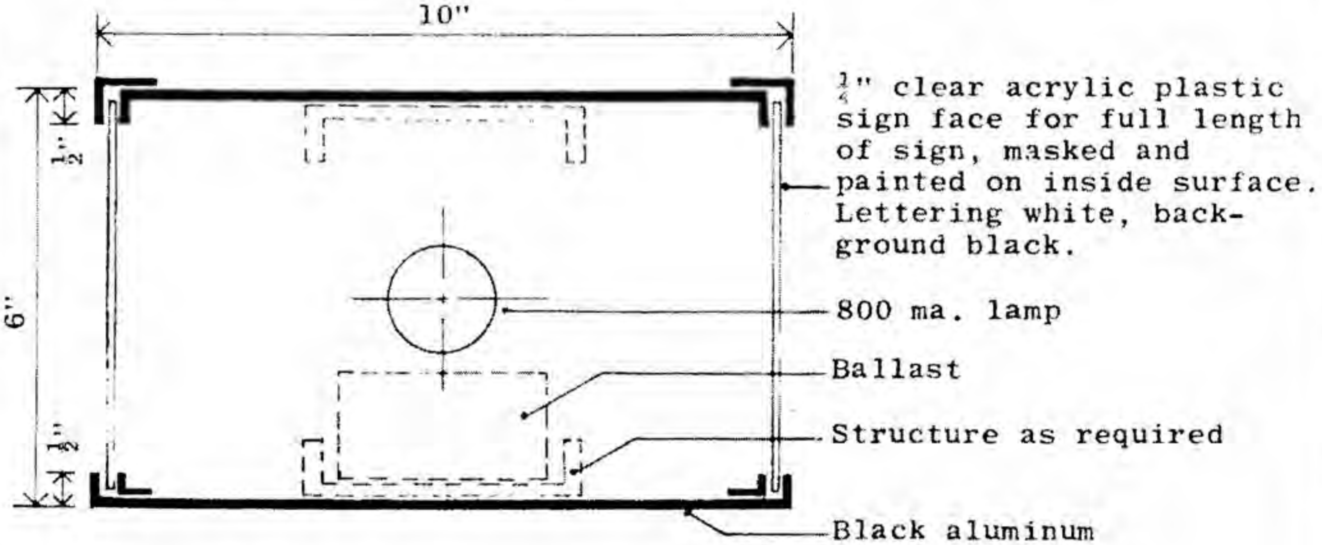
Both single faced and double faced (as shown) signs may be required. For lettering and layout measurements see Part V, Graphics Manual.

Sign Exterior is schematic only. In dimensions and appearance this sign is a standard component with no variation permitted.

Internally-Illuminated Signs



Longitudinal Section - at lapped lamps, where sign length does not accommodate standard lamp lengths.



Transverse Section

Both single faced and double faced (as shown) signs may be required. For lettering and layout requirements see Part V, Graphics Manual.

Sign interior is schematic only. In dimensions and appearance this sign is a standard component with no variation permitted.

Internally-Illuminated Signs

Design Criteria

Commercial Facilities occur in many stations. They generally consist of the following:

a. Newsstands
b. Lockers (Coin-operated)
c. Public telephones

Other commercial enterprises, or concessions, occur in certain stations but are not typical. The inclusion of such enterprises within stations is desirable, provided that adequate space is available, that the proposed enterprise is suitable in terms of appearance, clientele, and function to a station, and that the identity of MBTA elements is in no way impaired. Inclusion of new or different enterprises will depend on a market analysis by the Authority and on the availability of interested concessionaires.

COMMERCIAL FACILITIES

Newsstands

a. The number and location of newsstands will vary. Smaller stations may have only newsboys or coin operated racks; larger stations may require several newsstands, both inside and outside the paid area.

b. Most newsstands sell magazines, newspapers, candy, tobacco, and similar items. The area required varies considerably.

c. Newsstands must be specially designed, or modernized, for each different installation. The design intention is that they be compact, without clutter or fussiness, and constructed of black metal and stainless steel, as are most other components. Where mewsstands can be built in, they should utilize the adjacent wall materials, and be designed to fit with the other wall elements.

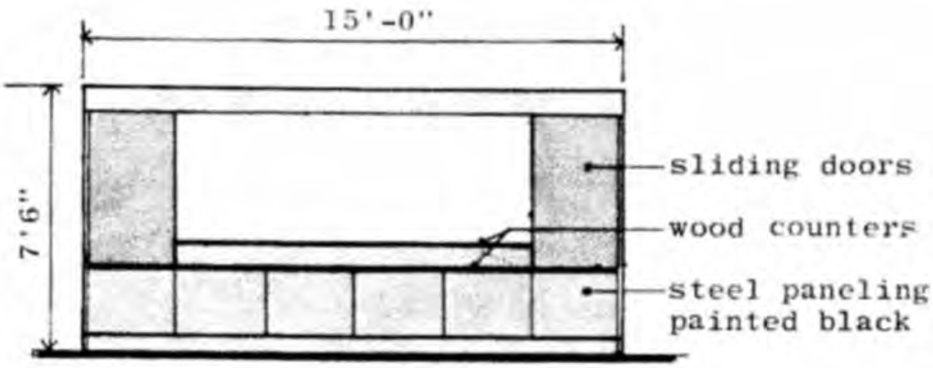
d. Since most newsstands operate only during rush hours, a system of demountable or sliding security panels must be provided for closing during non-operating hours.

e. Newsstands should be highly illuminated, and include an electric heater.

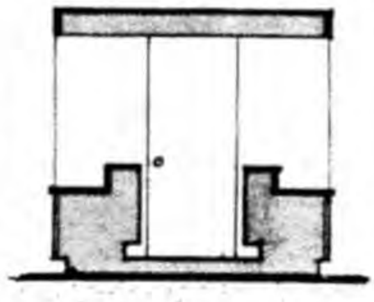
f. Newsstand graphics, see Part V, Graphics. The 9" fascia band will incorporate an illuminated sign, to match similar sign situations in other components.

g. Design and location of newsstands must be carried out in collaboration with the Concessionaire and the MBTA Planning Dept.

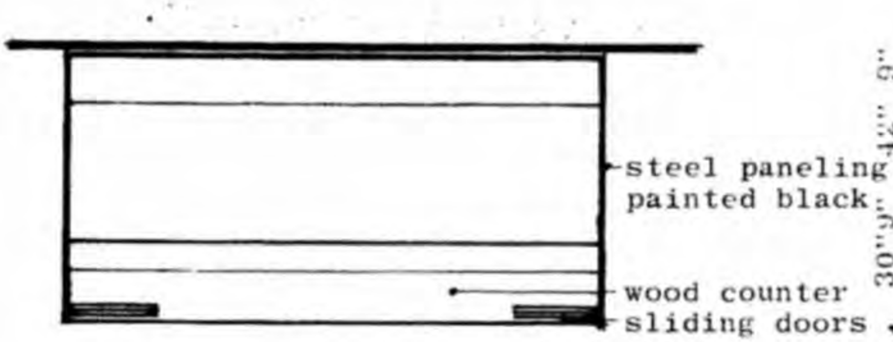
COMMERCIAL FACILITIES



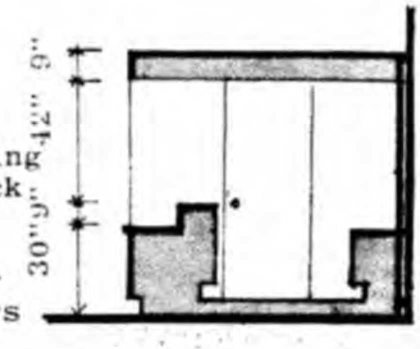
FRONT ELEVATION



SECTION, TYPE I



PLAN, TYPE II



SECTION, TYPE II

Newsstands

COMMERCIAL FACILITIES

Suggested Design

Telephone Booths

Design Criteria

a. Use of wall-mounted telephones in the subway system is currently discouraged. Glazed booths, without shelves or seats, are recommended. These may be freestanding, mounted against a wall or recessed.

b. Booths should be located where they will receive maximum public exposure, but not where they will actually interfere with circulation. They must be under continuous observation by Authority personnel, which will mean that in most cases they will occur only in mezzanines, near the fare collection line.

c. Where close to components such as collection booths and exit gates, the telephone booths should receive a black metal cap, which will strengthen them and relate them to the other tall components with similar caps.

d. If possible, booths should serve paid and unpaid areas. Failing that, serving the paid area is preferable.

e. Building-in of booths is desirable. If this is not practicable, they should be located to minimize small, hard to clean spaces behind and between booths.

f. Booth installation and maintenance is by the Telephone Company. Raceways should be provided either in the floor, overhead within lighting fixtures, or within walls, so that exposed wiring is, at most, a simple straight run.

Other Commercial Facilities

Concessions such as bakeries, flower shops, quick-lunch stands, etc. require such different facilities and occur in such a variety of situations that each must be treated as a separate problem, and specially designed, in accordance with the following guidelines.

1. Where more than one concessions (including newsstands) occur in a station, they should be located together for mutual reinforcement.

2. Concessions should be located where they will have maximum exposure to the public, especially to the public while waiting for trains, but should not interfere with station circulation. In many cases this will severely limit their size and shape.

3. Where concessions can be built-in, they whould utilize the adjacent wall material, and be designed to fit with the other wall elements. Free-standing concessions should be constructed of the same black metal and stainless steel as are most other non-built-in components, and incorporate the same 9" high fascia.

4. Each concession must have a means of secure closure for non-operating hours. This closure should leave none of the concessionaire's graphics, glass display windows or other materials exposed to view or vandalism. when closed. It should, furthermore, minimize the dirty and deserted appearance of a concession not presently rented.

5. The 9" fascia would contain an appropriate sign, backlighted by the lighting within the concession. This, unlighted, would be the only sign exposed to view when the concession is closed.

6. The concession itself, and its internal graphics should be highly illuminated, during operating hours.

7. All appliances, for cooking, space heating, etc., must be electrical. Location for concessions, and internal subdivisions therein, must take into consideration delivery requirements, waste storage and disposal, as well as the ease of providing water supply and drainage, if required.

COMMERCIAL FACILITIES

List of Items

A number of items dealing with safety, emergencies, and control occur consistently throughout the stations, and may be considered as components. These items are more precisely described in other parts of the Manual. The following list is intended as a brief introduction and referral.

Safety/Emergencies

a. Emergency lighting - required throughout each station. Refer to Part VI.

b. Emergency egress - Refer to this part.

c. Platform edge strip (safety yellow color) - Refer to Part VII. Strip 1'-6" wide. Surface texture must contrast with that of adjacent flooring.

d. Fire Extinguishers - required in electrical rooms, Refer to Part IX.

e. Dry standpipe system with connections at each lobby and platform.

f. Sprinklers and detector heads - not presently in use. Circumstances may require them in special areas.

g. Fire alarms and police call boxes - use as directed by the Authority.

h. ADT alarm - required on safe in primary collection booth. Refer to Part IX.

i. Escalator safety switches - required at top and bottom of escalators. Refer to this Part.

j. "B switch" to disconnect 3rd rail in station area located at leaving end of each platform.

k. Warning and forbidden access signs - Refer to Part V.

Control

a. Television surveillance system - required at some stations Refer to Part IX.

EXPLANATION

b. Paging and announcing system - required in all stations. Refer to Part XIII.

c. Starters call bell system - required in all stations. Refer to Part IX.

d. Emergency exit alarm - required on all emergency exits. Refer to Part IX.

Introduction

Authority facilities are subject to the requirement of the "State Building Code", though the code does not have provisions which apply specifically to rapid transit stations. In order to adequately handle emergencies involving fire and smoke in subway stations, the following criteria have been developed by the Authority in coordination with the Massachusetts Department of Public Safety and will be utilized in the design of new facilities.

Egress Requirement for Subway Stations:

Use of this method will provide egress facilities which will have sufficient capacity to provide safe, fast egress from the station under the worst combination of circumstances.

1) Determine net area of platform in square feet, deducting the space occupied by stairways, escalators elevators, structure, furnishings, concession or service spaces, and the 1'-6" platform edge safety stripe.

2) Divide the net area of the platform by 3 sq. ft. per person to determine the population to be evacuated.

3) Allow 3 minutes' time to clear the platform.

4) Assume a maximum rate of flow for emergency situations for vertical circulation elements including stairs, escalators, and ramps, of 45 persons per minute per 22 inch (1'-10") egress unit. (Horiz. passage, 60 p.p.m.)

Sample Calculation:

Net area of platform 9000
9000 sq. ft. ÷ 3 sq. ft per person = 3000 people
3000 people ÷ 3 minutes = 1000 persons per minute
1000 persons per minute ÷ 45 persons per minute = 22.2
say 22.5 egress units (at 22 inches)

EXPLANATION

As a shortcut, divide the net area of the platform by 405 to obtain the number of egress units. Note that one half an egress unit must be 12 inches or more in width.

Criteria for Location and Design of Egress Facilities for Subway Station

Vertical and horizontal circulation elements will be designed to meet the requirements of this manual (see Vol. IV Components) and the "State Building Code", as interpreted in this section to apply to subway stations.

1) Maximum distance on a platform to an exit is 150 feet, assuming no sprinkler system. (Thus, the maximum distance between exits equals 300 feet) The track tunnel is not counted as an exit.

2) "Dead end" spaces at the end of a platform exceeding 20 feet in length are not permitted, thus there must be a normal or emergency exit at each end of a platform.

3) End of station emergency exits should be easily accessible to the platform and tunnel but separated from them by walls and doors having a 2-hour rating. Such exits may also connect with lobby areas, but also require a 2-hour rated separation. When emergency exits are combined with vent shafts, they must be separated by a 2-hour rated wall.

4) A station lobby (mezzanine) must have access to the outside of sufficient capacity to handle the emergency flow fed to it from the train platforms.

5) A mezzanine may be open to the platform and trainway if its area is less than one-third of the platform and trainway which it covers. If there are two separate mezzanines, their total area should not exceed one-third of the area covered below.

6) Exits from a lobby(mezzanine) to the outside should be capable of being closed-off at the lobby level to prevent intrusion of smoke in emergency situations. (For security, a means of closing entrances at surface level is also required.) When mezzanines are larger than stated in item 5 above, they must be separated from the platform, preferably with doors at the platform level.

7) Absolute minimum width of an emergency exit stair is two

EXPLANATION

22 inch egress units or 44" (3'-8") wall to wall. Preferred minimum is 3 egress units or 5'-6", which allows enough space for easy maneuvering of stretchers and other emergency gear. The absolute minimum width of stairs for normal use is 5"-6" wall to wall. Actual width should be designed to meet requirements of peak traffic flow and emergency egress criteria.

8) At all subway stations with connecting underground busways or other vehicular circulation elements, or with connecting passageways to other uses, such as stores or office buildings, a separation between the train platform/lobby complex and these other activities will be provided to prevent intrusion of smoke.

9) All construction of service rooms and concessions within the station complex should meet a 2-hour rating.

Related Mechanical Systems for Subway Stations

Ventilation and fire detection, alarm, and supression systems are described elsewhere in the Manual (see IX Service Facilities and XI Ventilation), and in the "IRT Handbook for Subway Ventilation". The foregoing criteria for egress assumes that the following facilities or systems are provided:

1) A mechanically operated exhaust system for the station operating independently of that provided in the tunnels. In the train and platform area exhaust inlets should be spaced along the platform so that smoke does not have to be drawn a long distance through an occupied area. At high platform stations (Red, Orange, Blue Line) the preferred location of the exhaust duct is under the platform. At low platform (Green Line) stations other locations are possible. This system will be used for both emergency and normal ventilation and will be both locally and remotely controlled. Exhaust ducts or fans may be required at other locations within the platform and lobby complex.

2) A mechanically operated fresh air supply system for the station is also required. In emergencies it should be able to supply 50 percent more air than the exhaust system can remove, thus pressurizing the occupied space. As in the case of the exhaust system, local and remote control is required.

EXPLANATION

3) A smoke and fire detection system will be provided in the train tunnel, and in stations. In addition to the trainway, this system should be installed in concession areas, service rooms, and mechanical/electrical rooms where fires could occur. All systems will be tied to the control center.

4) A dry standpipe system will be installed in the train tunnel and in stations, with connections at 100 foot intervals.

5) A fire alarm system connected to the Authority control center and to local fire departments will be provided at all stations.

Egress Requirements for Outdoor Stations:

Stations located in open cut, at grade, or on viaduct structures do not experience the same exposure to fire and smoke hazards that subway stations are subjected to. Therefore, platforms with or without canopy or windbreak structures will be considered to be outdoor areas and not subject to the egress criteria for subways. Enclosed lobbies above or below the track level should be treated as occupied spaces and have egress with sufficient capacity to handle a maximum occupancy at 3 sq. ft. per person spread over the net floor area of the lobby, and a maximum evacuation time of 3 minutes. The platform, being outside, would be considered as a safe area. Lobby spaces in these stations are normally closed off from the platform and outdoor areas for security and weather protection. Smoke and fire detection systems, and a mechanical ventilation system will be provided for the lobby and other enclosed service spaces. At outdoor stations where platform areas are not directly accessible to fire apparatus (for example, due to presence of walls, structures, main line railroad tracks, etc.) a dry standpipe system will be provided.

Exceptions to this Criteria

In situations where severe restraints occur which make it impossible to meet the criteria described in this section, the appeal process may be used.

EXPLANATION

MASSACHUSETTS
BAY
TRANSPORTATION
AUTHORITY

GUIDELINES AND STANDARDS
PART V
GRAPHICS
REVISED 1977

GENERAL INTRODUCTION

The Massachusetts Bay Transportation Authority has found it both necessary and possible to concentrate attention on the complex needs of people. Programs to improve service must now include a new emphasis on the quality of the transportation experience. In effect, transportation engineering has been joined by human engineering and environmental design.

This manual provides a framework for the continued coordination of all those elements in the system that affect human comfort.

Many of the criteria involved are common to all environments, such as the control of light, noise, humidity, temperature, wind, and odors, or the need for orderliness, through clear and easy circulation and clean appearance. Other criteria that are more specific to the transportation environment are such needs as safety, traffic handling capability, spatial variety, consistently available information, and orientation.

The most important single criterion that has guided the preparation of this manual is the need for orientation. The rider must not only be physically comfortable, he must also know in the fullest sense where he is and where he is going.

Since to the layman a public transportation system is to a large extent an invisible skeleton of the city and metropolitan region, the comprehension of that structure generates an awareness and appreciation of the city itself, and an appreciation of travel through it.

There are many aspects to achieving this orientation. Circulation at all points must be direct and open. Spaces should relate visually to their surrounding environment, either through direct openings to adjacent spaces and structures, or in the case of platforms, by graphic reflection through photographic murals.

Above all, the need for orientation places great emphasis on maps and a consistent system of identification and directional signing. Graphics then emerges as a major factor in the design of each environment, a factor that must be given high priority in the early design phases of each project.

It is hoped that all participants in all programs will familiarize themselves with the entire manual, so that the implications of each decision can be understood in a system-wide context.

The standards and guidelines presented here are not inflexible rules. They are a framework for meaningful development and variety, and offer no restriction to the capacity of each participant to evolve better solutions to old or new problems.

As new solutions are developed and approved, revised and additional pages for the manual will be issued to all participants.

This Part of the Manual includes guidelines and standards for a wide variety of graphic elements occurring in diverse locations and media for the purposes of clear public information and Authority identification.

Each item has been developed in careful coordination with all other items, so that together they will operate as a system. It is essential, if this graphic system is to work effectively, that all participants give special attention not only to consistency of use of each element, but to consistency of quality as each item is reproduced or installed.

Consistent graphic quality contributes substantially to the Authority's public "image", and to achieve it will often require a concern for precision and for subtle visual relationships not required in other areas of the design program.

As the Graphics Program advances, many special conditions will arise that are not fully covered in this Manual. This will be true especially in the areas of printing and station signing. Some of these conditions will become standard items and will be described in new manual pages. Others should be developed individually, following manual guidelines as closely as possible.

Regarding station design, it should be noted, above all, that graphics must be given careful consideration at the earliest phases of design development. Signs, maps and photomurals have an impact on orientation and station environment at an architectural scale, and as such they must be integrated from the outset with structure and space rather than be merely added as afterthoughts.

For general application of graphic elements in stations, see Part I, Guidelines and Principles. For specific examples of locating major graphic elements in stations, see Part III, Station Modernization Program. For fabrication details of items such as signs, see Part IV, Components.

INTRODUCTION

PART V GRAPHICS

MANUAL OF GUIDELINES AND STANDARDS

The symbol has been developed to identify the Authority's services; verbally as a name, and visually as an image.

Lettering for the Authority name has also been developed to act as secondary visual identification using a special carefully selected alphabet set in flush-left lines. The Symbol and Authority name will perform their visual functions most effectively if they are carefully and consistently used, and if they are never altered in any way.

For sample uses in specific situations, refer to Section M (Printing), and to Sections D, E, I, K, and N.

General Guidelines

1. The symbol should be used primarily in black on a white background. Additional uses include black on light grey backgrounds, and grey on white backgrounds.

2. For special purposes that will not confuse with rapid transit color coding, the symbol may also be used in white on backgrounds of solid saturated color. Do not print the symbol in black on deep colors. Do not print the symbol in pastel colors, and do not print the symbol on patterned backgrounds.

3. The symbol should never be crowded by other visual elements, or closely approached by lines or other forms. With the exception of the Authority Name, Line Names, Rapid Transit Lines, as shown on maps, no typography should be located in close adjacency to the symbol.

4. When the symbol and Authority name are used together, they should almost invariably combine with each other horizontally, as shown on sheet A5.0. If necessary for reasons of vertical format, they may be combined vertically, as shown on sheet A5.0.

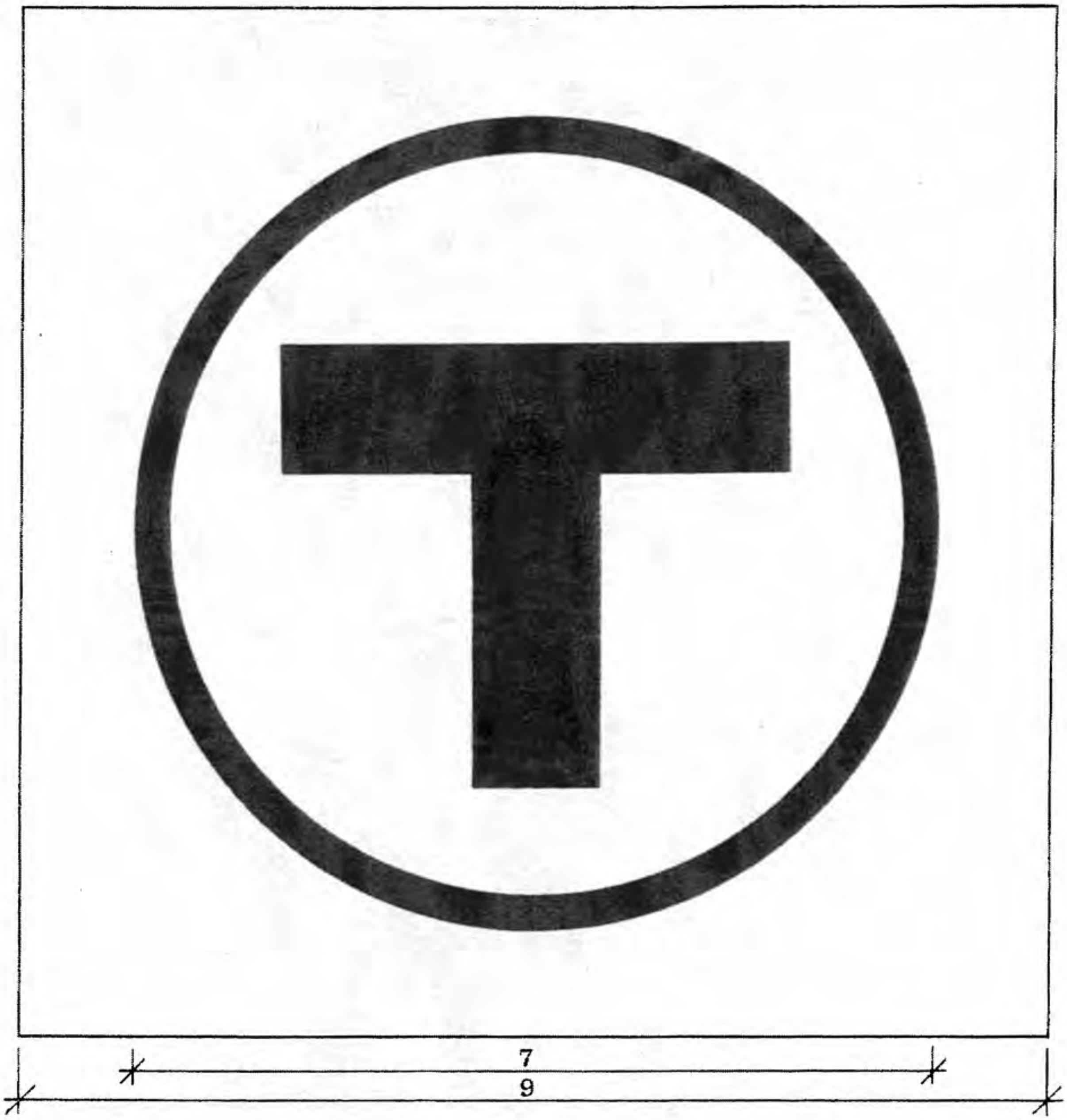
5. The Authority name may also be used as a single horizontal line, as shown on sheet A5.2, but only in situations of limited space (such as passes), or where the name has a minimal function (such as the small identification line on wallet maps).

6. The symbol and Authority name should only be reproduced, enlarged or reduced by photographic means. Do not attempt to reproduce by hand, or to change size by proportional dimensions. Reproduce the symbol only from originals with sharp edges and square corners.

GENERAL DESCRIPTION AND GUIDELINES

Enlarge or reduce photographically only. For diameter 4" and smaller, see Sheet A2.1.

SYMBOL, DIAMETER LARGER THAN 4"



The symbol must be in a 7:9 ratio with the background. See Sheet A1.0 for notes on usage. See Section K (Bus Stop Signs) for a typical application.

SYMBOL ON A SQUARE PANEL, WHITE

letter height

MASSACHUSETTS

½ l.h.

letter height

BAY

½ l.h.

letter height

TRANSPORTATION

½ l.h.

letter height

AUTHORITY

Use the Authority name exactly as it is shown on these pages. Change the size of the name by photographic process only. Artwork should be obtained from the Authority. Do not use these pages as artwork. They are examples for size only.

The Authority name must always appear in the Standard Alphabet - Helvetica Medium, and flush left as shown here. Line spacing remains the same at all sizes except 8 pt., 7 pt., and 6 pt. These are set solid because of their frequent use in restricted positions.

Do not use other alphabets, no matter how similar they may seem. Do not alter the flush left margin. Do not alter the spacing between lines. Note that special relationships exist between letters within the words.

For flush-left margin rule see C5.0.

AUTHORITY NAME

The primary fuction of the Authority's color coding is to give clear identity and structure to the routes of the Rapid Transit Lines. When carried out consistently on a system-wide basis, on station signs and many other elements, color coding will help significantly in making the system legible.

The colors Red, Blue, Green, and Orange have been reserved for the Rapid Transit Lines, and Purple for Commuter Rail Lines, and Yellow for buses. The color Brown has also been reserved for a future additional line. To prevent confusion, these colors must not be used on signs for any purposes other than identification of the Rapid Transit Lines, except as noted in this Manual.

These colors, or shades of these colors, and other colors used for station finishes must not compete or conflict with the color coding system. Large areas of a line color may be used to emphasize the identification of a line, particularly in stations where two rapid transit lines connect.

The vehicle color scheme is an extension of the line color coding systems. Typcially, the vehicles have light gray roof and skirts, a white band in the window area, and the line color band between floor and belt rail.

The color Yellow is also used for signal and warning purposes. Yellow is used for platform safety striping, service vehicles, and any other purposes that require maximum visibility for safety. It must not, however, be used as a background color for signs.

EXPLANATION AND GUIDELINES - GENERAL

The Authority's standard colors are of necessity applied to a wide variety of materials and surfaces, using many different inks and paints. These include porcelain enamel on steel, spray-painted aluminum, papers of all types, polyvinyl fluoride films, back-illuminated acrylic plastics, plywood, and many others.

In each case it is extremely important to achieve the best possible color match to the samples in this manual, and to prototypes previously developed and approved. For example, on Red Line and Orange Line signs, do not use any red and orange that seem close when exact matches are possible, since confusion between the two colors may result.

Note that the colors are called "RTL Red", "MBTA Grey #1", etc. and that each is a specific shade and hue. These specific colors must be used consistently throughout the system on all signs, maps, printed materials, vehicle painting, station painting, etc.

EXPLANATION AND GUIDELINES - COLOR MATCHING

Standard Colors

Color	Use	Chart No.	(Spray) IMRON Code No.*	(Brush) DULUX Code No.*
Red	Red Line	Red	93-58209H	93-58209H
Blue	Blue Line	66	77257U	93-77257
Orange	Orange Line	14	60659U	93-60659H
Green	Green Line	94	5316U	93-5316
Yellow	Bus, Trackless Trolley Chrome Yellow	-		93-6808
Dark Grey	System Wide	-		93-55322
Light Grey	" "	55	55137U	93-55137
White	" "	48	817U	93-21667
Beige	" "	44	4480U	93-96923
Purple	Commuter Rail	-	1976 UM	(Hyde)
Aqua	Handicapped	78	72218U	93-72218
Black	System Wide	59	99U	93-005

* On Dupont Dulux and Imron Transportation Finish Master Color Guide

The above colors have been designated as standard colors for the Authority. This does not constitute an endorsement of a particular brand, but is used for convenience due to the wide availability of color samples and paints. These particular colors are ones which can be most successfully matched in the porcelain enamel process. The Authority can provide porcelain enamel color samples to contractors as required.

MBTA Standard Colors for Printed Material (Paper Stock):

Color	Use	(Pantone Nos.) Uncoated Stock	Coated Stock
Red	Red Line	485*	485
Blue	Blue Line	293	285
Orange	Orange Line	144*	152
Green	Green Line	348*	348*
Yellow	Bus, Trackless Trolley	123	123
Purple	Commuter Rail	241	249*
Aqua	Handicapped	334	334

* As these are not an exact match, they are the closest pantone has to offer.

The Authority's standard alphabet, called Helvetica Medium, has been chosen for maximum legibility at all sizes and availability in many media. Since the consistant use of one alphabet on all signs, maps and printed matter contributes substantially to the Authority's visual unity, no other alphabet should be substituted however similar it may appear to be.

Spacing rules from letter to letter and word to word are based on the optical weight of each letter shape. These should be followed exactly. Note that spacing rules for backlit signs are more open, to compensate for the optical expansion, or flare, of backlit letters and words.

For applications requiring a lighter type face, such as text (see Section M, Printing) a machine-set variation, called Helvetica (Light), is available. An extra bold variation, called Helvetica Bold, is used exclusively for terminal names on maps (see Section D). For diverse applications of the alphabet, see other Sections of this Manual.

General Guidelines

1. The spacing rules given on Sheets C2.0-C2.2 must be followed on all signs requiring lettering of 1" cap height or larger. Do not enlarge to these sizes photographically from smaller type-set copy, as spacing will be different and less legible.

2. For applications requiring lettering smaller than 1", copy may be set in type and ordered from most type compositors, either as printed reproduction proofs from lead type, or as photographic proofs from phototype negatives.

3. Do not attempt to reproduce lettering by hand at any size, or to cut silk screen stencils by hand. For large sizes, such as signs and vehicle markings, use die cut pressure sensitive film letters applied directly, or prepare silk screen stencils photographically from finished artwork that has been made up using compositor's proofs, die cut film letters, or transfer wax letters.

continued

EXPLANATION AND GUIDELINES

4. Note that Helvetica Medium is available in wax transfer letters (by Letraset or equal) in a large variety of sizes from most artist supply stores. These wax letters are not durable, but can be used for temporary signs, for signs not subject to abrasion (such as office doors), for the preparation of artwork, and for lettering on architectural and engineering drawings. Do not attempt to compose lines of copy in very small sizes using these transfer letters, where compositor's proofs can be used with more precise results.

5. When a change of size is required from proofs or artwork, this should be done exclusively using photographic techniques (film negatives and glossy prints), or photostats (glossy negatives and glossy prints) so as to maintain dimensional accuracy, sharpness, and consistant lettering weight.

6. Note that the design of almost all items for the Authority using stacked lines of typography sets the lines either flush left or flush right. Do not center lines under each other, except as shown in Section M, and special cases noted as such in Sections F and G.

EXPLANATION AND GUIDELINES - GENERAL

ABCDEFGHIJKLMN
OPQRSTUVWXYZ
1234567890&'.,;:-!()

LETTER SPACING

A-A = 1 unit
A-C = 2 units
A-S = 3½ units
C-C = 4 units
C-S = 5 units
S-S = 7 units

(A = angle letter
C = curve letter
S = straight letter.)

WORD SPACING (CAPS TO CAPS)
For word spacing of lower case and caps, see II-1.0

A-A = 14 units
A-C = 15 units
A-S = 17 units
C-C = 18 units
C-S = 19 units
S-S = 22 units

SCALE OF SPACING UNITS
32 UNITS = CAP HEIGHT

Use clear film sheet with scales for various letter heights

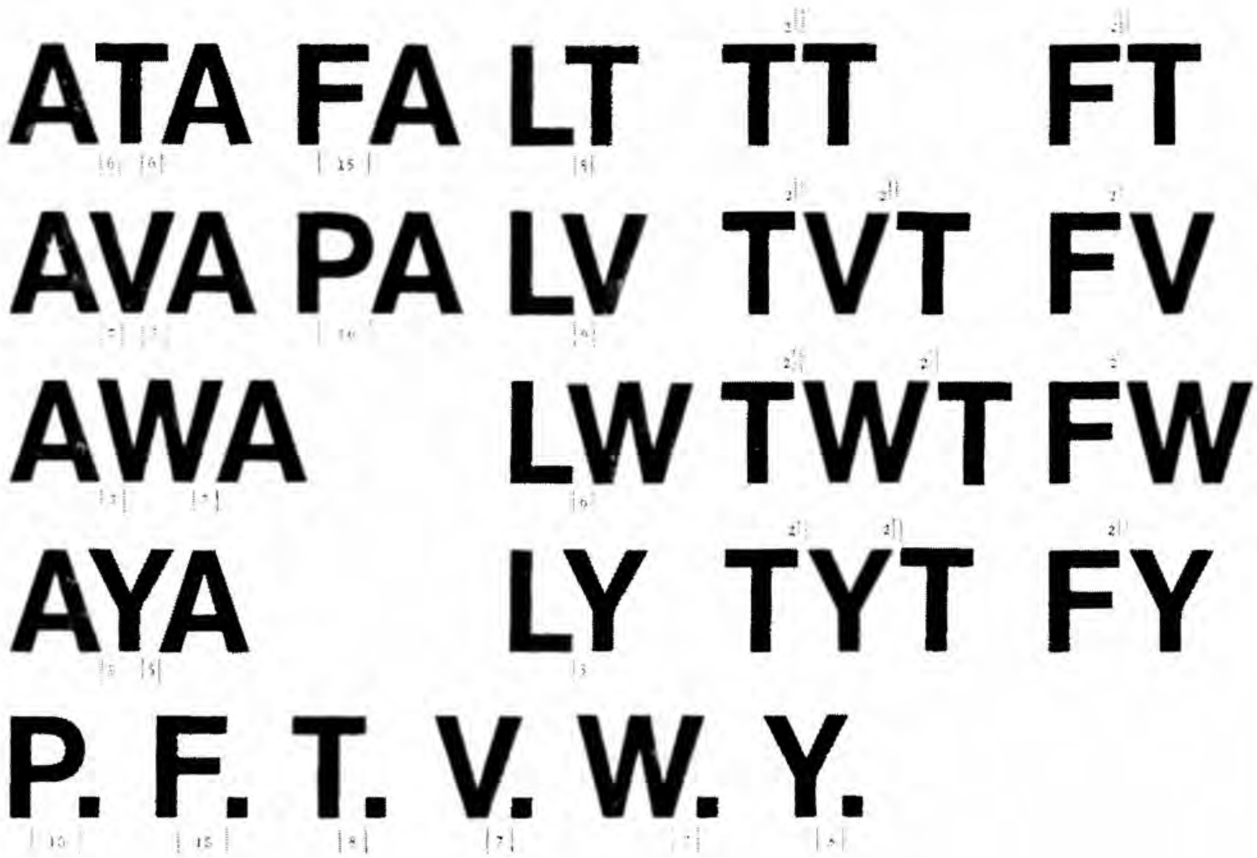
EXIT TO BUS 21 AND

SPECIAL SPACING CONDITIONS - See E2.1

This alphabet is "Helvetica" medium. For applications requiring small sizes, type or proofs can be ordered from most compositors.

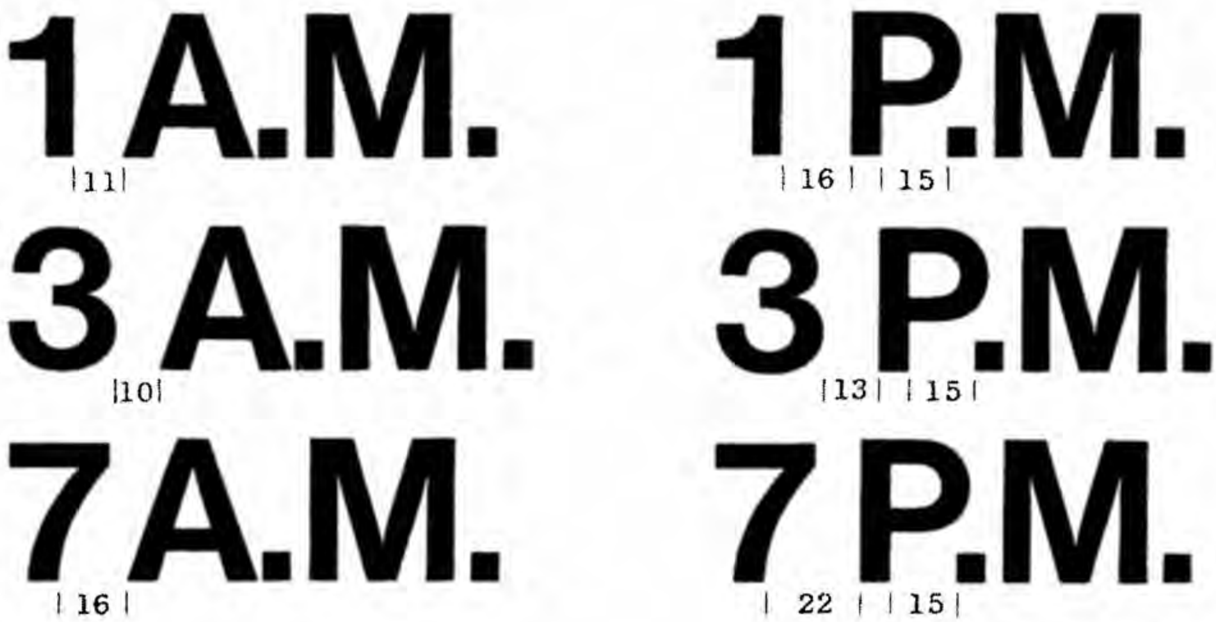
Alphabets also available in wax transfer letters by "Letraset" Co. from most artists' or architects' suppliers, and in pre-cut films for pressure sensitive exterior and interior applications.

OPAQUE SIGNS - ALPHABET AND SPACING RULES



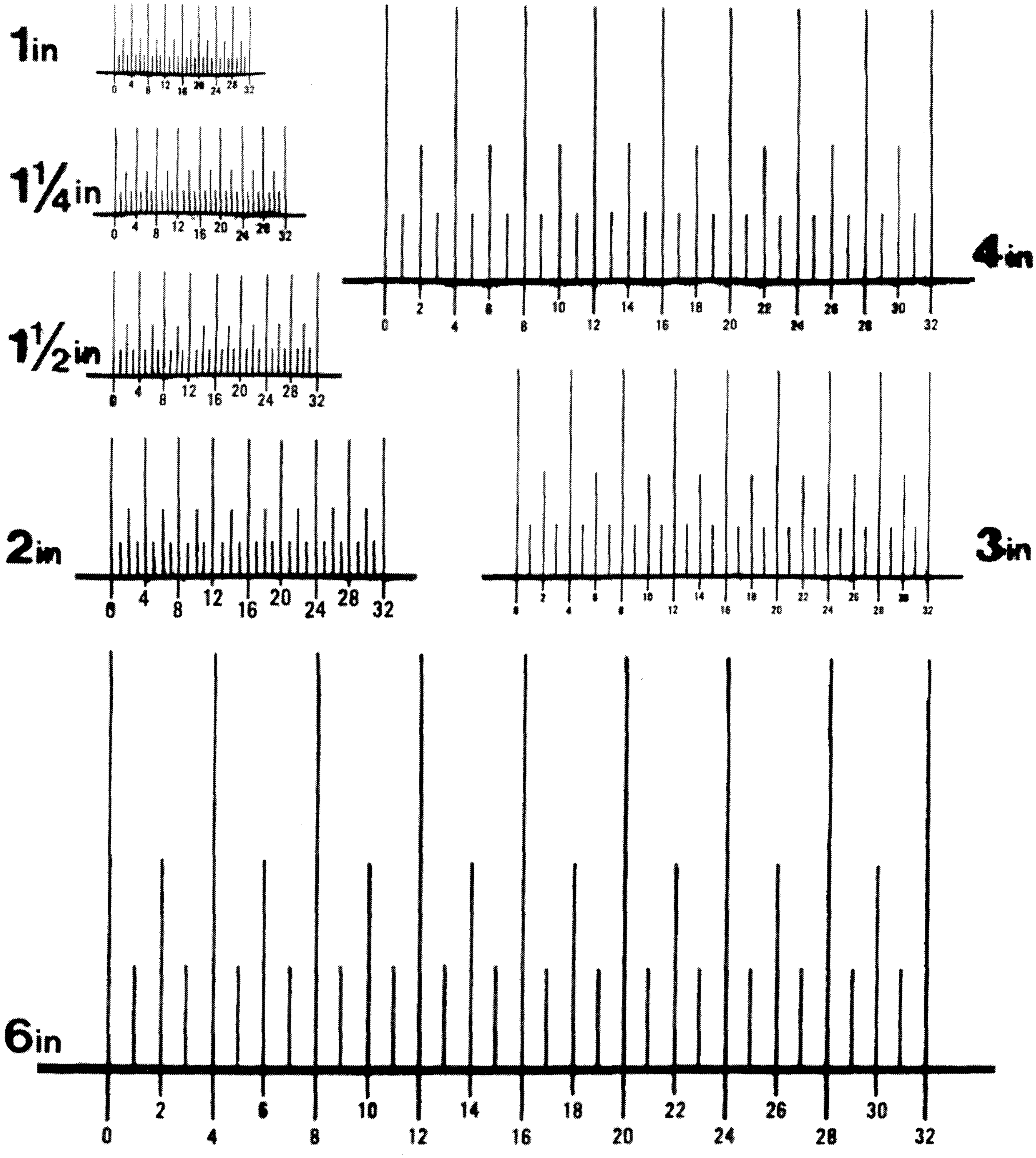
SPECIAL SPACING CONDITIONS - OPAQUE SIGNS

Use these spacing units wherever these combinations occur.

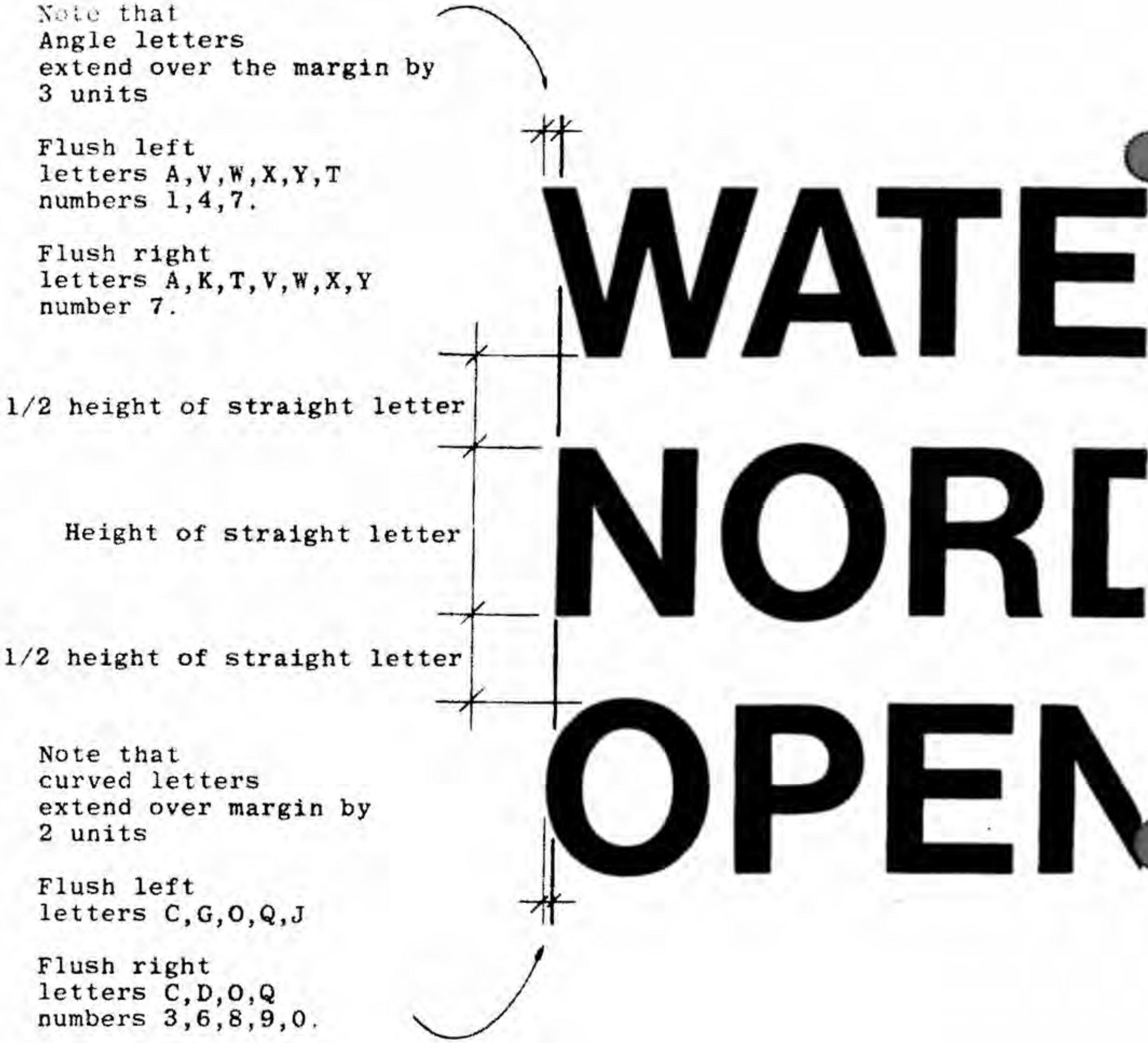


Use these special spacing relationships when combining numerals with letters A.M. and P.M. to make opaque signs regarding times. Note that numeral-to-letter spacing is one-half the normal word spacing modified and adjusted to the Special Spacing Conditions.

OPAQUE SIGNS, SPECIAL NUMERAL CASES



SPACING SCALE FOR STANDARD CAP HEIGHT



These rules also apply to lists that are flush right. Line spacing only applies to lists with lettering all same size.

<u>FLUSH LEFT RULE, LINE SPACING RULE</u>

For all signing (except for special cases shown in following sections) lettering must relate to signband in a 2:3 ratio whether black letters on a white background, white letters on a black background, or white letters on a colored background. Examples are 4" letters on a 6" signband and 6" letters on a 9" signband.

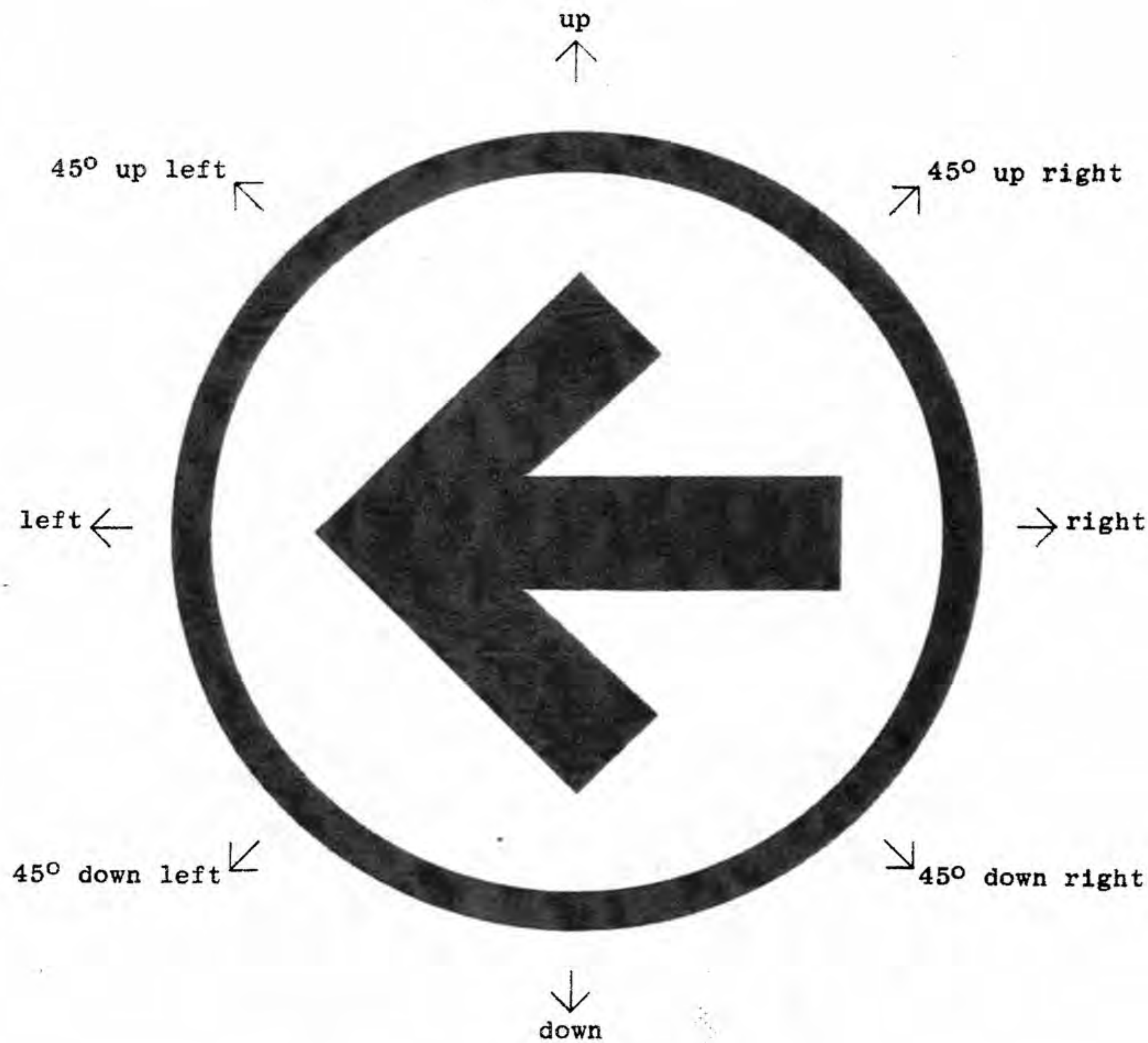
NOTE: Cap height is always measured on a straight-edged letter.

<u>LETTER HEIGHT ON SIGNBAND, PROPORTION RULE</u>

Stacked white signbands are separated by a 1/4" black line. Line/Direction units use no line, since color background butts white background (See F6.0, 6.1).

Line/Direction units (entering and transferring signs) are separated from other directional signbands by a full 6" black band (See F6.4).

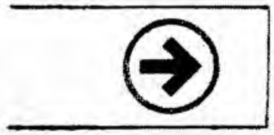
SIGN BAND HEIGHTS - STACKED SIGN



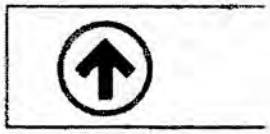
This arrow - circle unit is to be used on all directional signs, and only in the eight attitudes shown. For correct usage, see Sheet C7.1. Do not use the arrow without the circle, except as specified in this manual for special application.

ARROW/CIRCLE

Go left

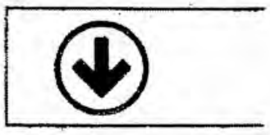


Go right

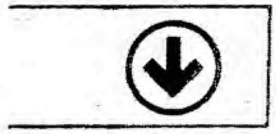


Go up

Go up



Go down or straight
You have arrived



Go down or straight
You have arrived

Up left,
or half-left

Up right,
or half-right

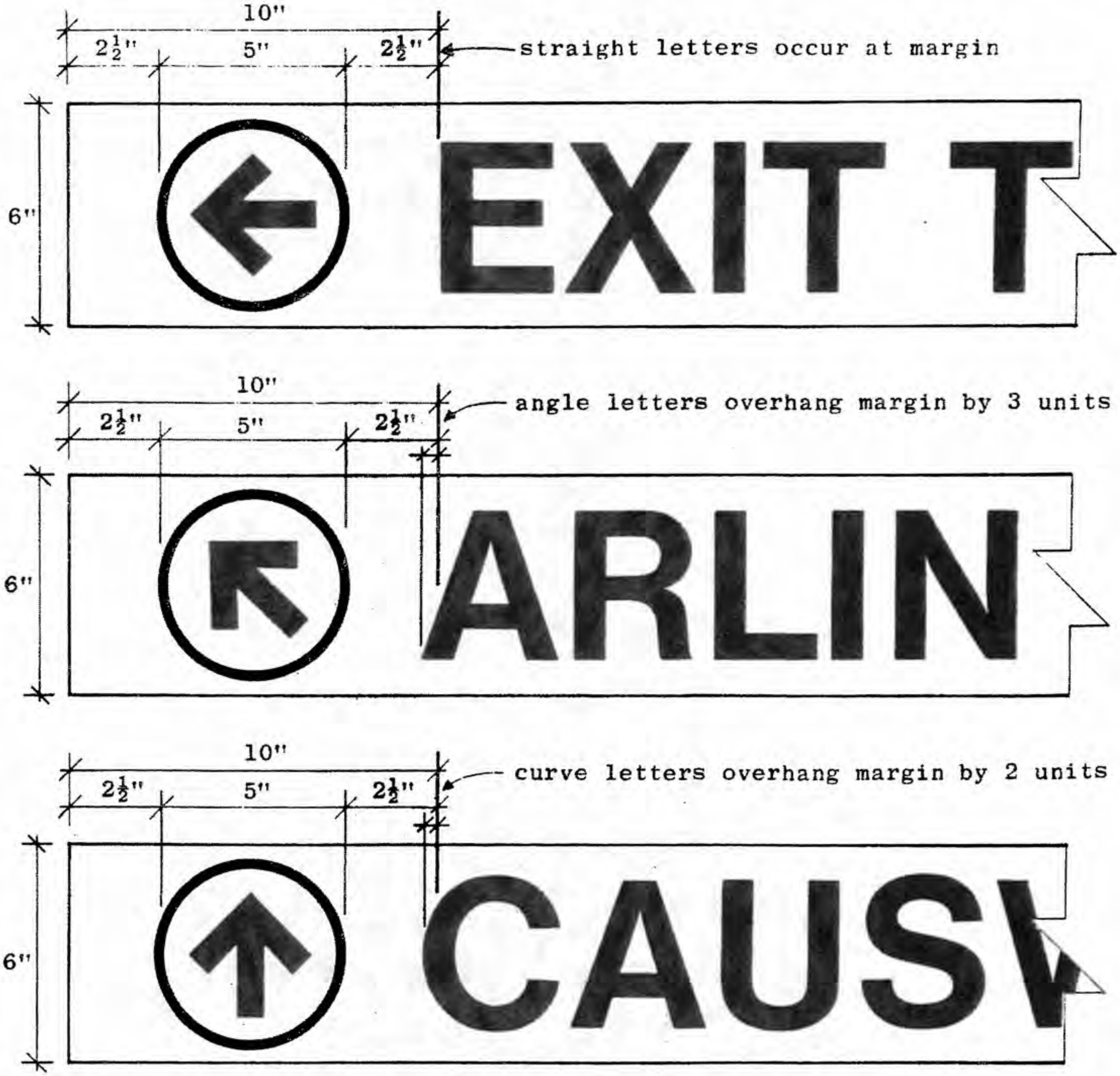
Down left only

Down right only

These are the proper attitude positions for the Arrow/Circle decal. Use the Arrow/Circle either left or right. Do not use on both sides of a sign unless one end or the other is obscured by a column, wall, etc. from some viewing positions.

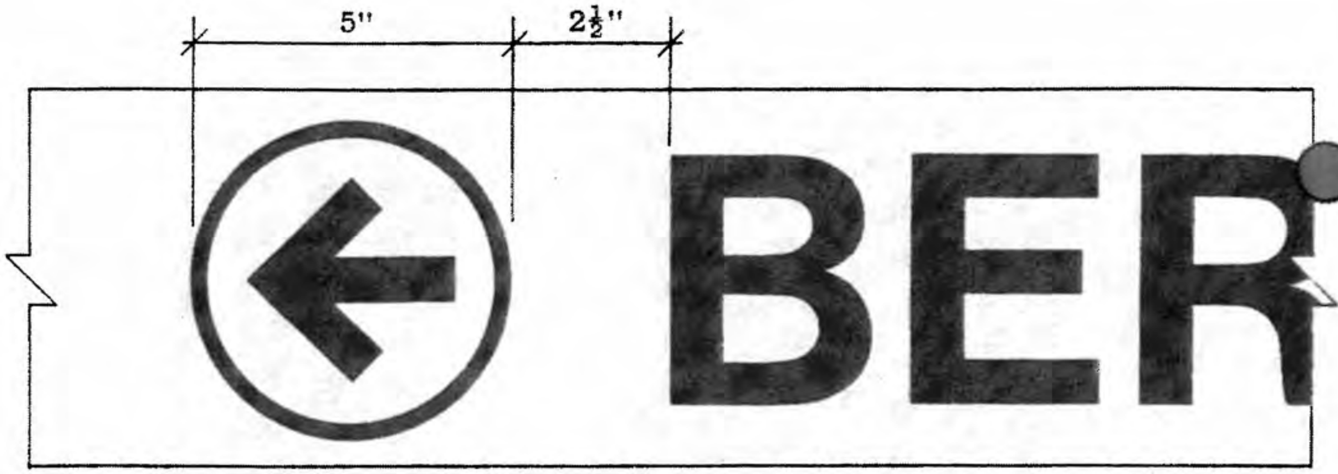
See C8.0 and C8.1 for relationships to the edge of the sign.
See Sections F and G for use.

ARROW/CIRCLE - DIRECTIONAL CONVENTIONS

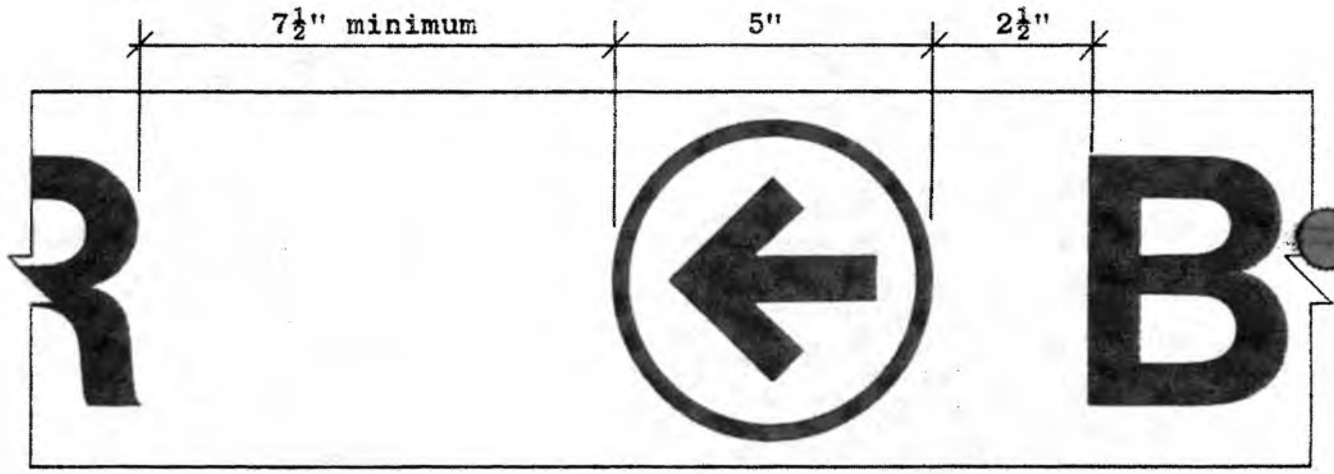


Lettering height relates to signband height in a 2:3 ratio, and to Arrow/Circle diameter in a 4:5 ratio. On a 6" signband, letters are 4" high and the Arrow/Circle diameter is 5". The outside edge of the Arrow/Circle is 3½" from left edge of signband and 3½" from lettering margin. Spacing remains the same with the Arrow/Circle and lettering on the right side of signs.

<u>USE OF ARROW/CIRCLE - OPAQUE SIGN BANDS</u>

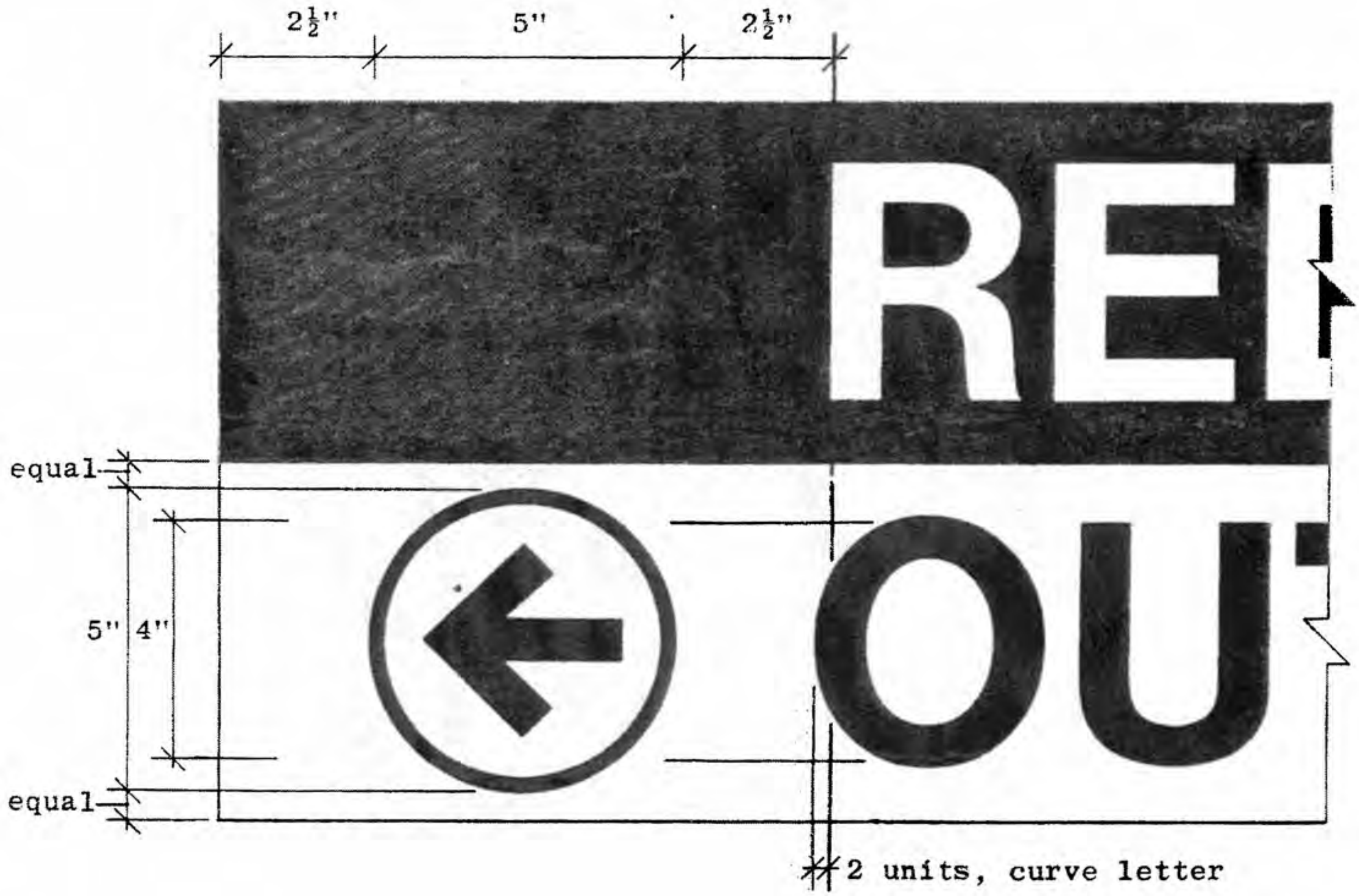


Single floating directional sign



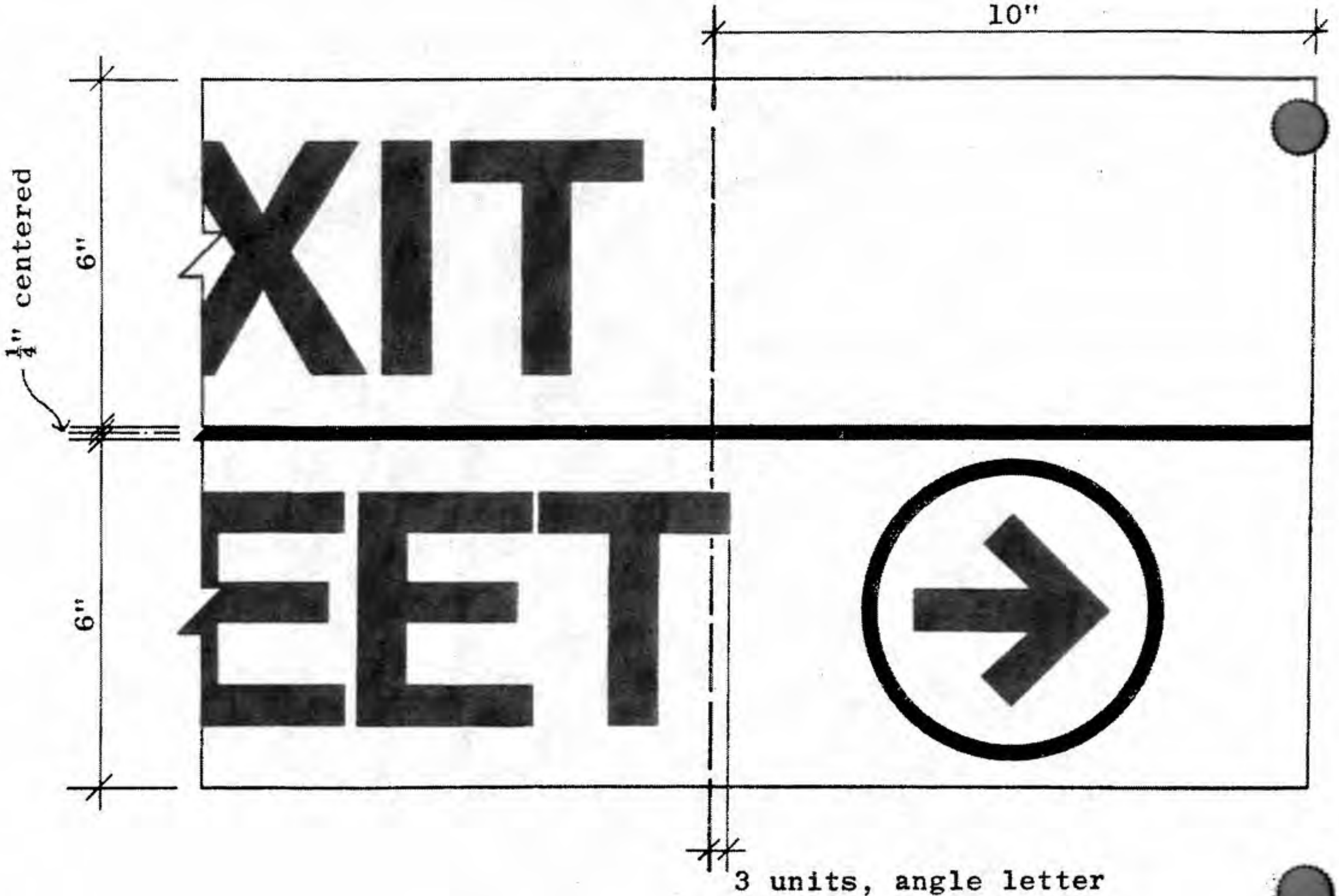
Two adjacent directional signs

USE OF ARROW/CIRCLE - CONTINUOUS OPAQUE SIGN BAND



On signbands that provide information together, as a pair, the arrow must only appear once, on the white band. For typical combinations of this kind, see Sections F and G.

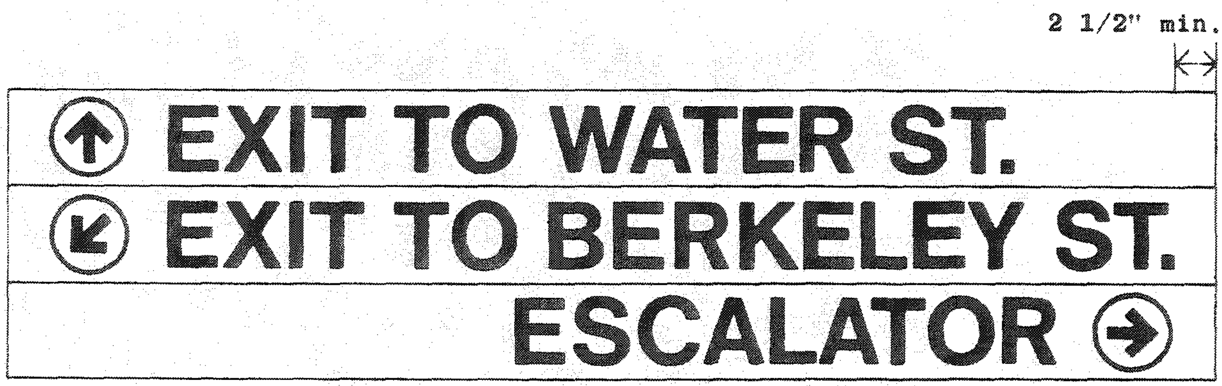
USE OF ARROW/CIRCLE - LINE/DIRECTION SIGNS



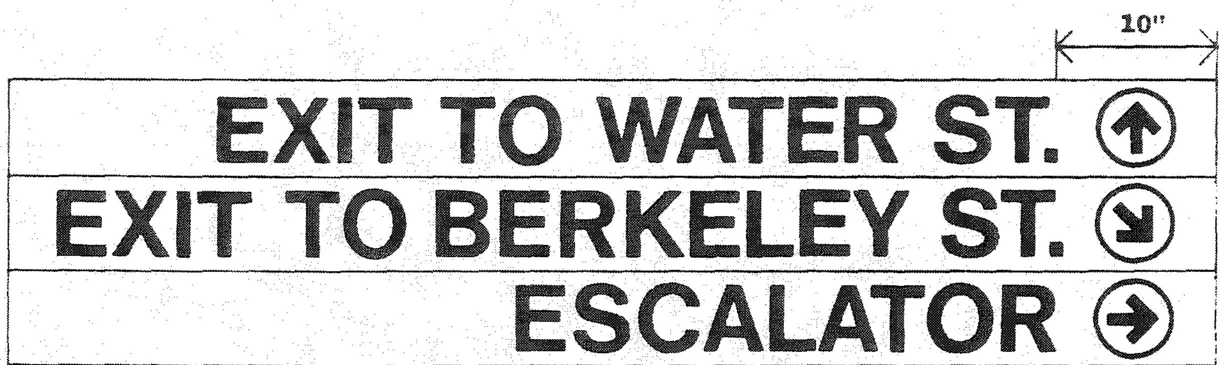
Maintain the left or right margin of a signing band in the adjacent bands. Do not allow the lettering of one line to run across the margin of one directly above or below it.

Note that lettering two lines away may violate the margin to gain copy-fitting space. See Sections F and G.

USE OF ARROW/CIRCLE - DIRECTIONAL SIGNS, MARGIN RULE



A. STACKED SIGN - SPLIT CIRCULATION



B. STACKED SIGN - BRANCH CIRCULATION

A. Orient copy on sign flush left or flush right depending on left or right circulation decision. If circulation is straight ahead or down, arrow may be left or right (left preferred).

B. If circulation branches to only the right (or left), position all the arrows on the right side of the sign (left side of the sign).

See Sections F and G for combinations of various sign types.

<u>USE OF ARROW/CIRCLE - STACKED SIGN BANDS</u>

a. Top band should be flush left, or middle band should be moved to top. Sign bands should not, without necessity, alternate left-right (See sheet C6.4).

Top band also violates directional signs margin rule (See sheet C8.4).

b. Arrow and copy should be shifted flush left. Arrow should never point toward copy.

c. Arrow and copy should be shifted flush left. Information should never be centered, except on continuous sign bands of indefinite length.

<u>ARROW/CIRCLE - INCORRECT USAGE</u>

The Authority's maps are designed to provide information in varying degrees of detail according to specific needs.

Transit information is often required by passengers in a hurry, as a quick reference. In response to this, the Strip Maps ("Line" Maps) within the rapid transit cars allow the sequence of stations and transfer points to be read at a glance. Similarly, the RTL Map gives schematic structure and clarity to the entire rapid transit system and is also designed to be read quickly. Unessential information is eliminated.

In each case, the maps are designed for maximum clarity and for consistency with their overall map family in type, color and symbols. Additional or revised maps that may be required from time to time must maintain this consistency within their map family.

In addition to the families of transit maps, a neighborhood map is to be provided in each station as a public service. Transit information such as connecting bus routes and the locations of bus stops are included where they occur, but the primary purpose of the maps is to provide detailed information about streets, address numbers and points of interest in the neighborhood surrounding the stations. A "You Are Here" decal, applied individually to each map, further helps to orient the passenger.

It should be noted that the coding system of the maps uses three major elements: Color for the Rapid Transit Lines, Letters for branches of the Rapid Transit Lines, and Numbers for the Bus Routes. These coordinate with roller destination signs and with bus stop signs as shown in Sections J and K.

GENERAL DESCRIPTION

Comprehension of the signing system, and of its application at stations, becomes clear if one traces all possible passenger routes and analyzes each decision point for the essential information required at that point.

This section of the Manual outlines the use of basic signing types encountered by the entering passenger (some of which are also encountered by the transferring passenger).

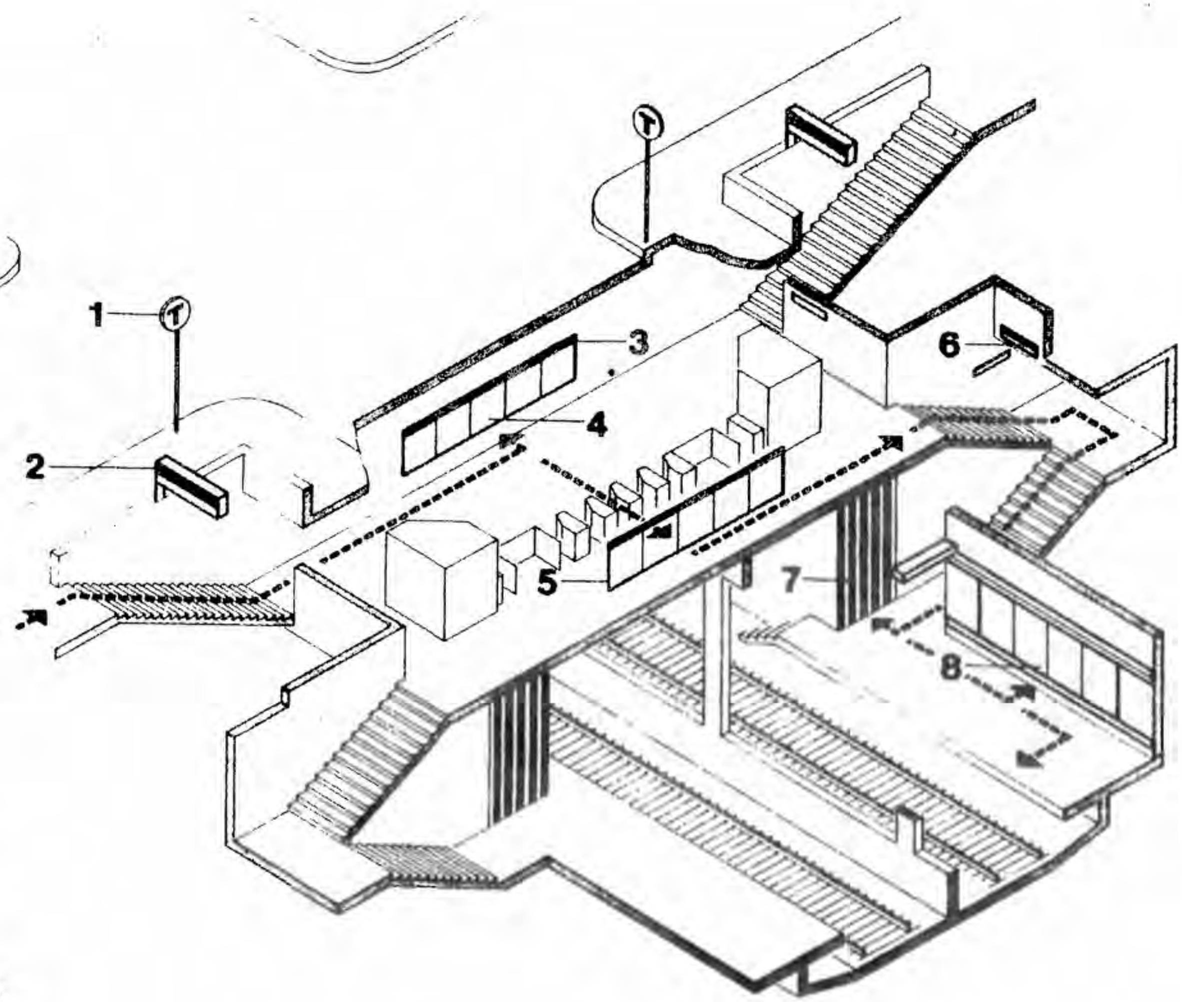
The entering sequence begins with the passenger's approach route to the station along city streets, and ends with his boarding the correct train for his destination.

There are basic criteria that should be remembered in signing each decision point: designation of all choices, maximum visibility and maximum simplicity. Unessential information should not be included, particularly in narrow circulation areas where a lingering passenger may block traffic flow. Reference items to be studied in detail, such as maps, should be located only at fare collection lobbies, platforms and wide passageways where traffic will not become blocked.

In stations where existing wall space at fare collection areas is inadequate for the requirements of proper signing, it is extremely important to increase that wall space. Minimum surface should be 16', both inside and outside fare collection, and this should be accomplished by revision of existing walls or construction of new free standing panels.

Note that revenue advertising, as described in Section L, is in effect the last graphic item in the entering sequence, seen by the waiting passenger before he boards his train.

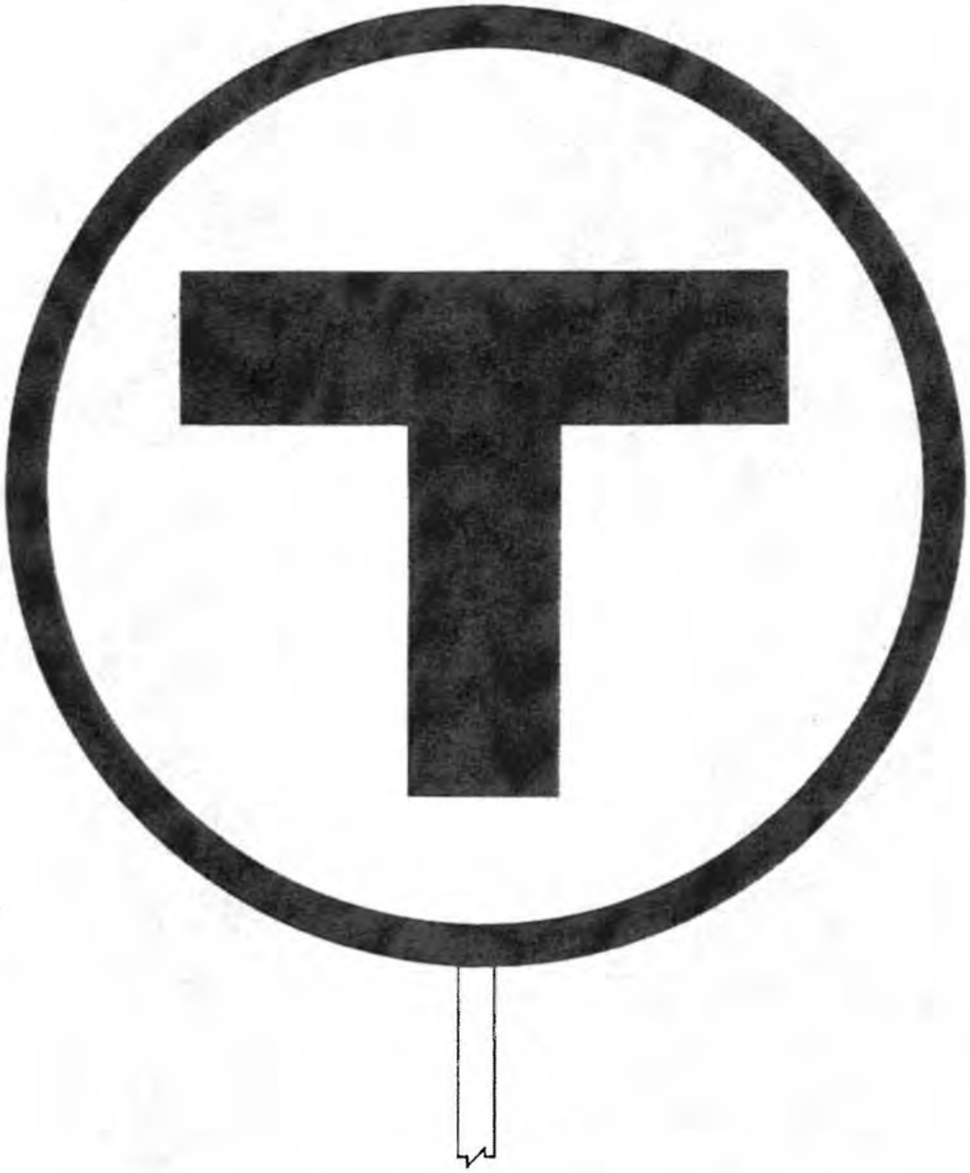
GENERAL DESCRIPTION



SIGN TYPE KEY

1. T Symbol
   Street Sign
2. Station Name
   Street Sign
3. Line Identification
4. Maps/Lists of Stations
   Outside Fare Collection
   (Non-directional)
5. Maps/Lists of Stations
   Inside Fare Collection
   (directional)
6. Line/Direction Sign
7. Inbound-Outbound Color Coding
   End Walls
8. Maps/List of Stations
   Platform

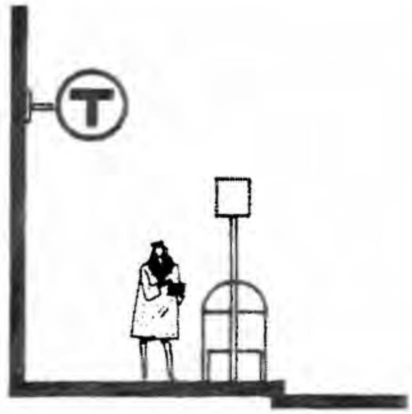
DIAGRAMMATIC ILLUSTRATION - SIGN TYPES



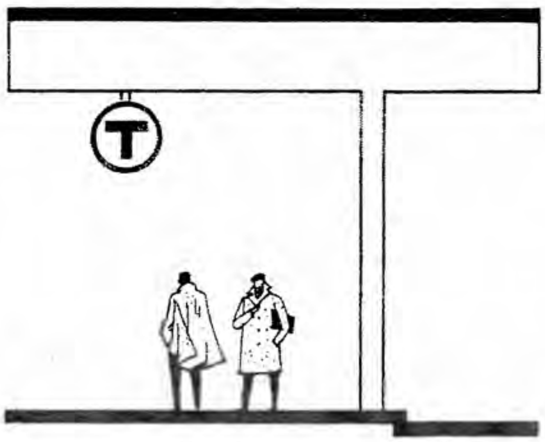
The basic T Symbol Backlit Street Sign is used to mark the location of RTL stations. See Part IV, Components, for dimensions, outline specifications and installation.

T SYMBOL - BACKLIT STREET SIGN

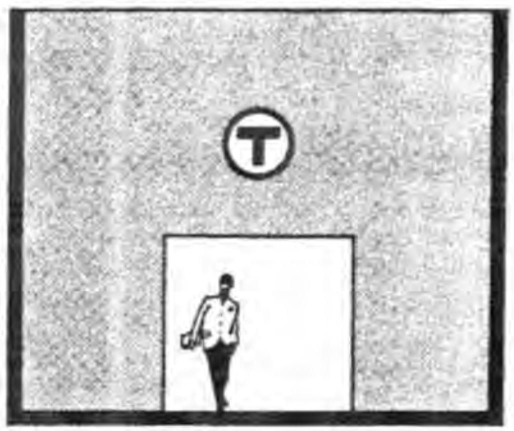
1. Pole Mount



2. Side Mount



3. Suspended Mount



4. Surface Mount

Use the Illuminated Symbol as a beacon to identify RTL stations at street or surface level (See I-H.6; IV-A8.0 - A8.4).

1. Pole Mount - standard application.
2. Side Mount - attach to nearby building or structure, where sidewalk is too narrow or crowded for pole.
3. Suspended Mount - hang symbol from major structure, where necessary to relate to visual environment.
4. Surface Mount - only where space prohibits either (1) or (2).

T SYMBOL - BACKLIT STREET SIGN - APPLICATIONS

ARLINGTON

THIS ENTRANCE WILL BE OPEN
5:15 A.M. - 1 A.M. DAILY

The basic Station Name and Hours sign is used over the entrance to RTL stations.

The Station Name appears in white on a background of the RTL color of line of the station. Name and Hours signs generally fill the full width of the opening to the RTL station.

The hours of opening appear in black on white in varying sizes. See following pages for copy-fitting samples and examples of entrance information.

Note: all lettering is centered within the width of the sign. This is the only case of RTL station signing in which lettering is neither flush-left or flush-right, except for the centering of copy within structural bays of the station platform.

<u>STATION NAME AND HOURS - BACKLIT STREET SIGN</u>

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

MANUAL OF GUIDELINES AND STANDARDS

REVISED 1977

GRAPHICS

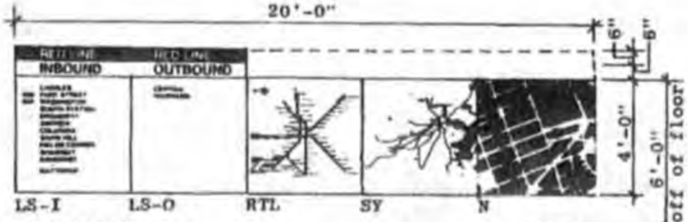
STATION ENTERING SIGNS

STATION NAME AND HOURS - BACKLIT STREET SIGN

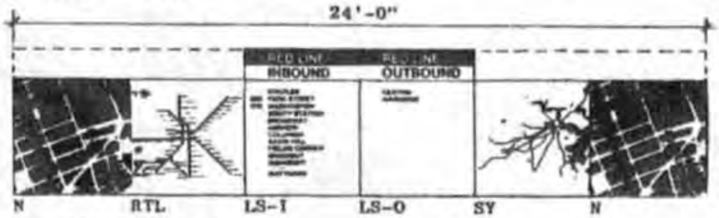
V

F3.1

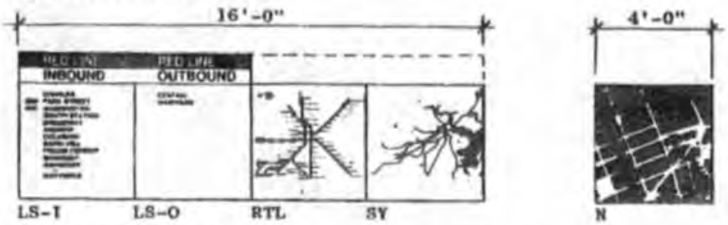
MAPS/LISTS OF STATIONS - NON-DIRECTIONAL COMBINATIONS



COMBINATION NO.1



COMBINATION NO. 2

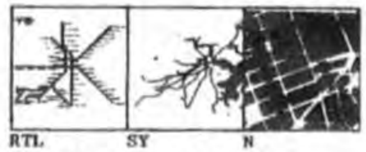


COMBINATION NO. 3

These combinations should be used at all stations and will usually occur outside fare collection.

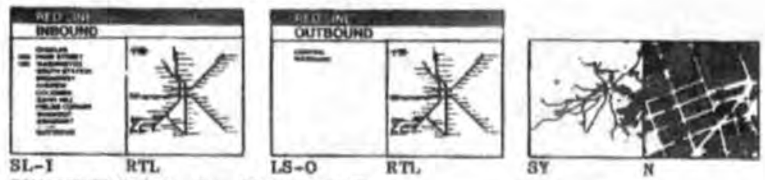
Use Combination No. 1 in all fare collection areas, where available continuous wall surface permits. Note that this combination is organized segmentally from left to right for entering circulation that is moving from left to right. Where entering circulation moves from right to left, the sequence should be from right to left. See also F4.1.

Use Combination No. 2 where available wall space permits, and where entering circulation approaches symmetrically from both sides. Note that in this non-directional situation, the Lists



COMBINATION NO. 4

COMBINATION NO. 5 - two triples



COMBINATION NO. 6 - three pairs

of Stations are kept adjacent to each other, so that they can be read simultaneously.

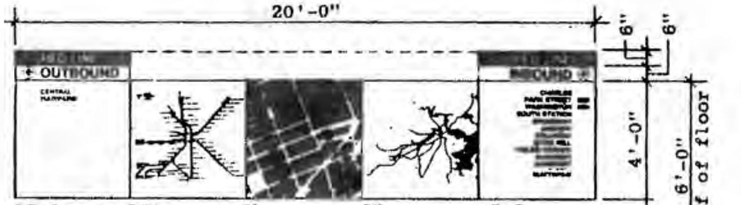
Use Combination No. 3 where the maximum possible continuous wall space allows only four units. Locate the Neighborhood map separately on any nearby available wall or on a free standing panel.

Use Combination No. 4 at entrances and fare collection areas where the maximum possible continuous wall surface allows only three units. In this non-directional situation, the Lists of Stations have lowest priority and are therefore eliminated.

Use Combination No. 5 at entrances and fare collection areas where available continuous wall surface allows two separated triples.

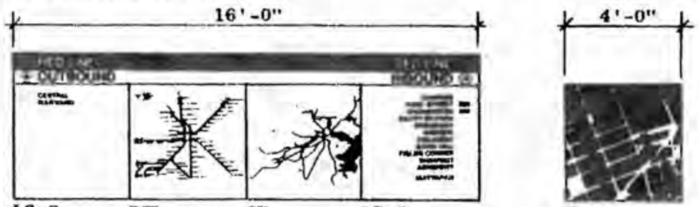
Use Combination No. 6 only in those situations where available continuous wall surface is severely limited.

Note that in all combinations using Lists of Stations, the RTL map is adjacent. These units are designed to work together.



LS-O RTL N SY LS-I

Combination No. 1

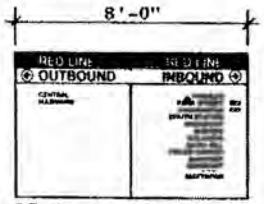


LS-O RTL SY LS-I N

Combination No. 2

LS-O RTL LS-I SY N

Combination No. 3



LS-O LS-I

Combination No. 4

LS-O LS-I

Combination No. 5

The combinations of maps and Lists of Stations occur at decision points, and therefore include directional arrows.

Use Combination No. 1 where available continuous wall space allows.

Use Combination No. 2 where maximum possible continuous wall space allows only four units. Locate the Neighborhood map on any nearby available wall or on a free standing panel.

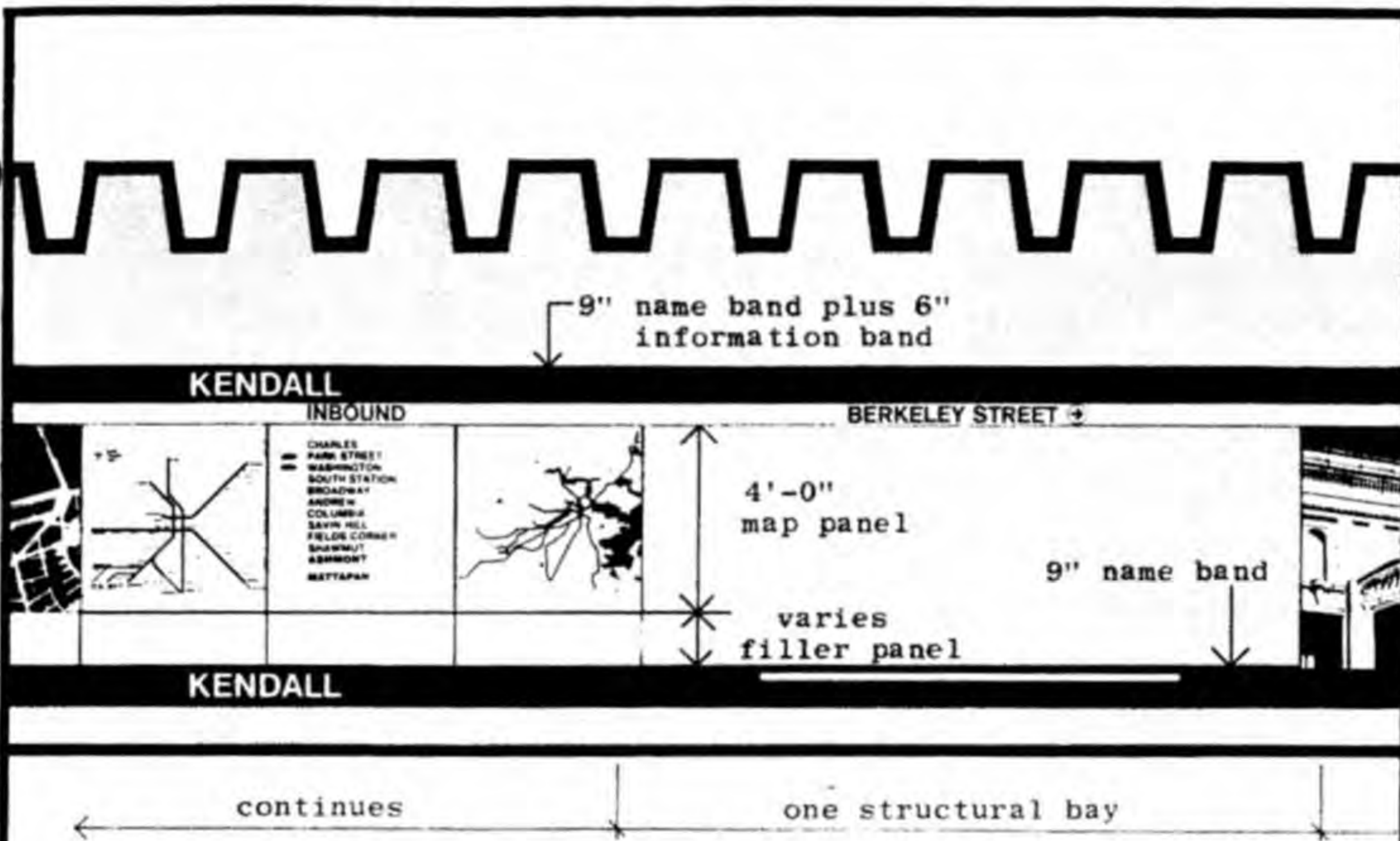
Use Combination No. 3 where maximum possible continuous wall space allows only three units. System and Neighborhood maps should be located nearby.

MAPS/LISTS OF STATIONS - DIRECTIONAL COMBINATIONS

Use Combination No. 4 at decision points where no additional wall space is available, or where no additional map units are desirable, such as at stair landings where traffic could be obstructed by persons reading the maps.

Use Combination No. 5 at those rare points where directional movement is the same, and reinforcement of List of Station information is desirable. An alternate to this sign is the "All Trains" unit shown on F6.0.

At critical decision points where no wall space is available, free-standing walls should be constructed to accommodate the largest possible of the Maps/List of Stations combinations. Note that by using both sides of free-standing panels, all maps can be easily shown in a limited space.

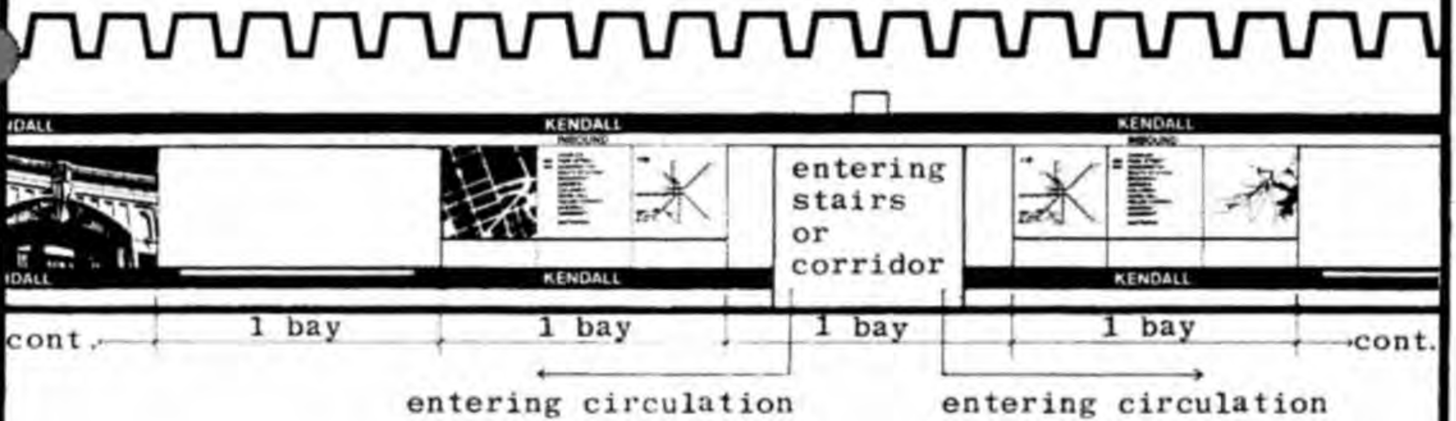


PLATFORM ELEVATION

In stations where the structural bay is greater than 15'-0" o.c., all four map units (LS, RTL, SY, and N) can be used together to make a 16'-0" map grouping. The photomurals which alternate with the map groupings may then be either 12'-0" (3 - 4'-0" pieces) or 16'-0" (4 - 4'-0" pieces). Room for adequate benching should be left between maps and photomurals.

If desired, the lower band can be used intermittently, occurring only at maps and photomurals. Where visibility of the upper band is adequate for persons on board trains, the lower band may be omitted.

MAPS/LISTS OF STATIONS - PLATFORM GROUPS OF FOUR



PLATFORM ELEVATION

This example is drawn to show a frequently encountered condition, a center loaded platform with 12' bays. It is not an accurate representation of a condition at Kendall Station.

Structural bays of approximately 12 feet dictate Maps/List of Stations in groups of three in order to relate to the architecture.

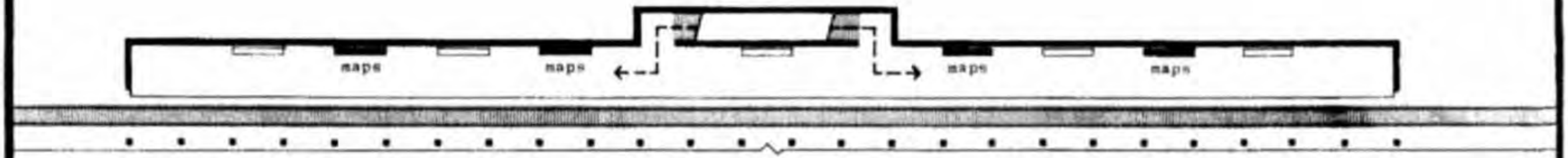
If desired, the lower band can be used intermittently, occuring only at maps and photomurals. Where visibility of the upper band is adequate for persons on board trains, the lower band may be omitted.

Note, however, that there are four basic units required at platforms: the appropriate LS for the platform, RTL map, SY map, and N map. This is true for both sides of the station.

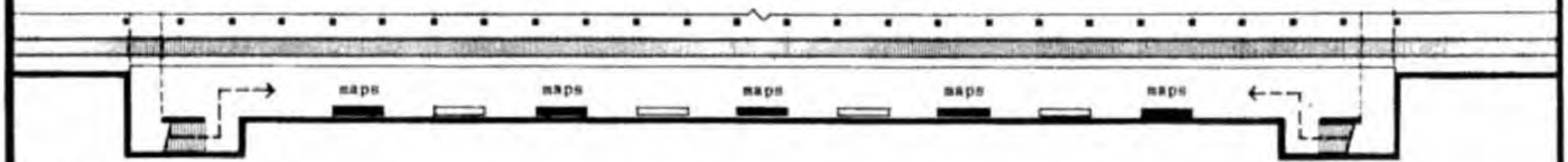
Groups of three should be formed as follows: Keep the LS and RTL always together as a pair, and alternate the use of the N and SY as the third unit.

Locate the LS directly under the Station Name in the Identity Band. Where possible, arrange the maps so that they relate to the circulation pattern. The RTL map is most important to entering traffic and should be seen first as one approaches the train. The opposite is true for exiting traffic, and the N map should be seen first as one leaves the platform.

MAPS/LIST OF STATIONS - PLATFORM COMBINATIONS - GROUPS OF THREE



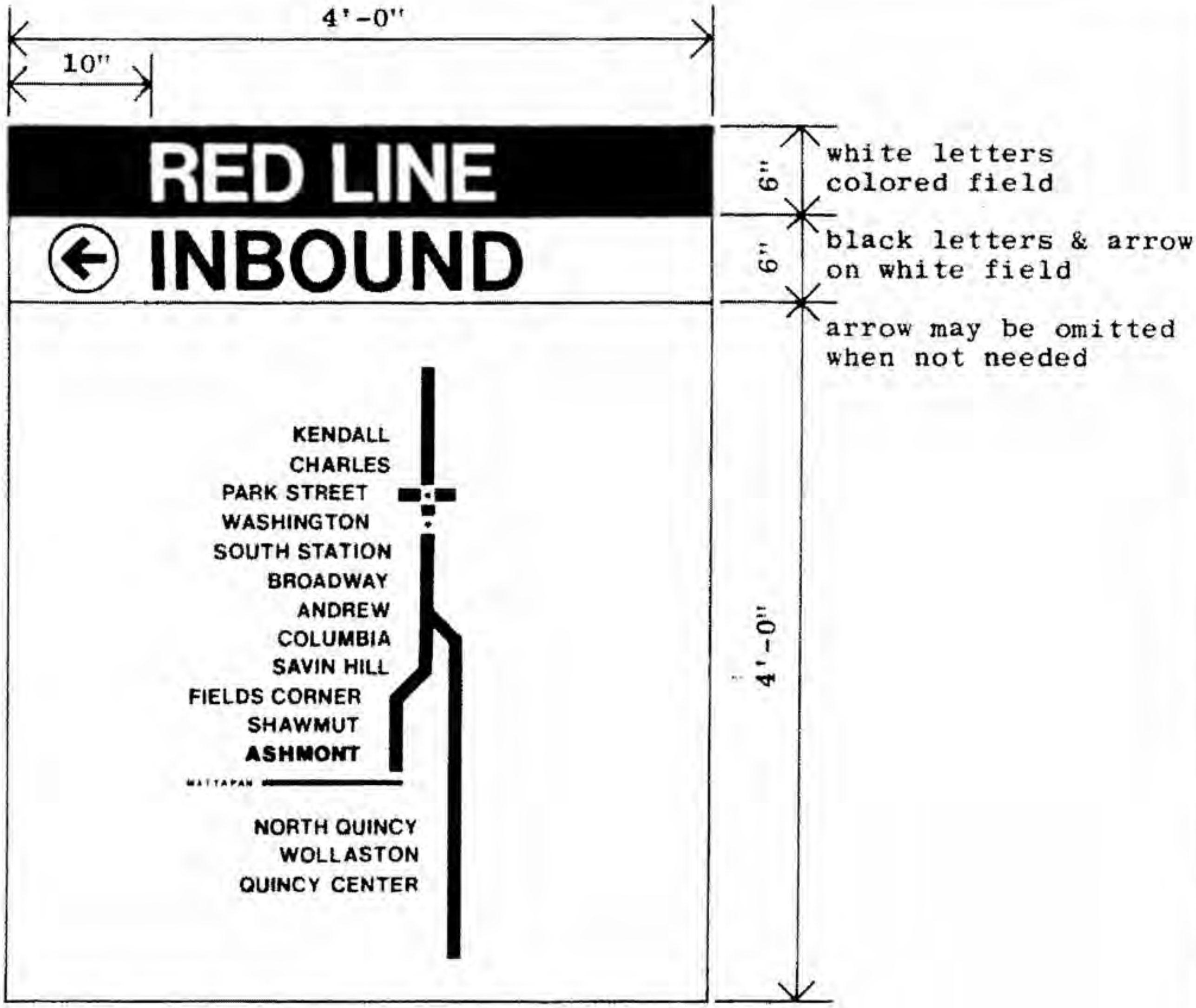
A. CENTRALLY-LOADED PLATFORM



B. END-LOADED PLATFORM

Map units should primarily be located near points of circulation to and from the platform, and secondarily, they should be distributed along the full length of the platform in rhythms alternating with the orientation photomurals. See also Section H.

MAPS/LISTS OF STATIONS - PLATFORM DISTRIBUTION

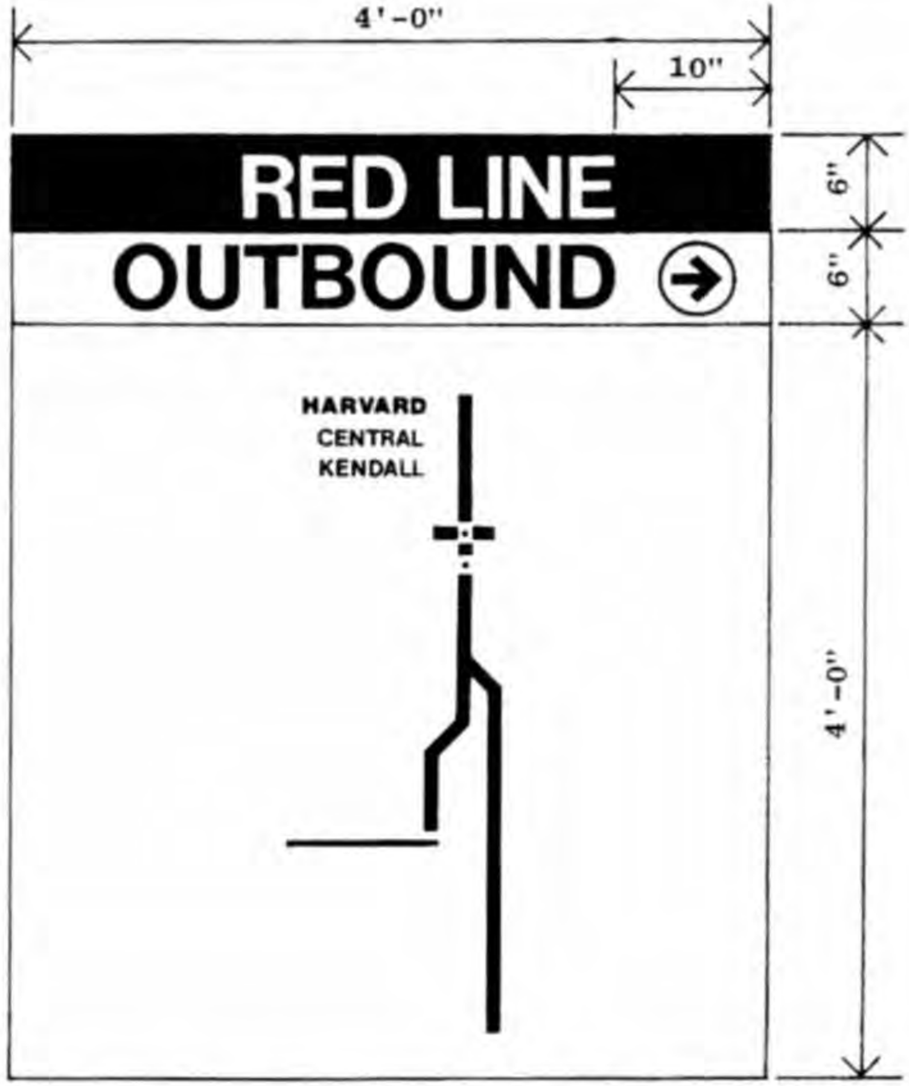


Sample Sign at Kendall Station Inbound

The purpose of these units is to allow a passenger to quickly determine the direction of trains to his destination so that he will know which platform to go to. As described on III-4.0 of the Manual, the Authority's system is basically radial, and the platforms are therefore designated inbound or outbound at all stations except at downtown stations where the lines cross.

Standard artwork used for all stations. Station names include the station where this sign is located and all stations to the terminal in a given direction. (Fabricator blanks out screen for omitted stations)

<u>LISTS OF STATIONS - INBOUND</u>

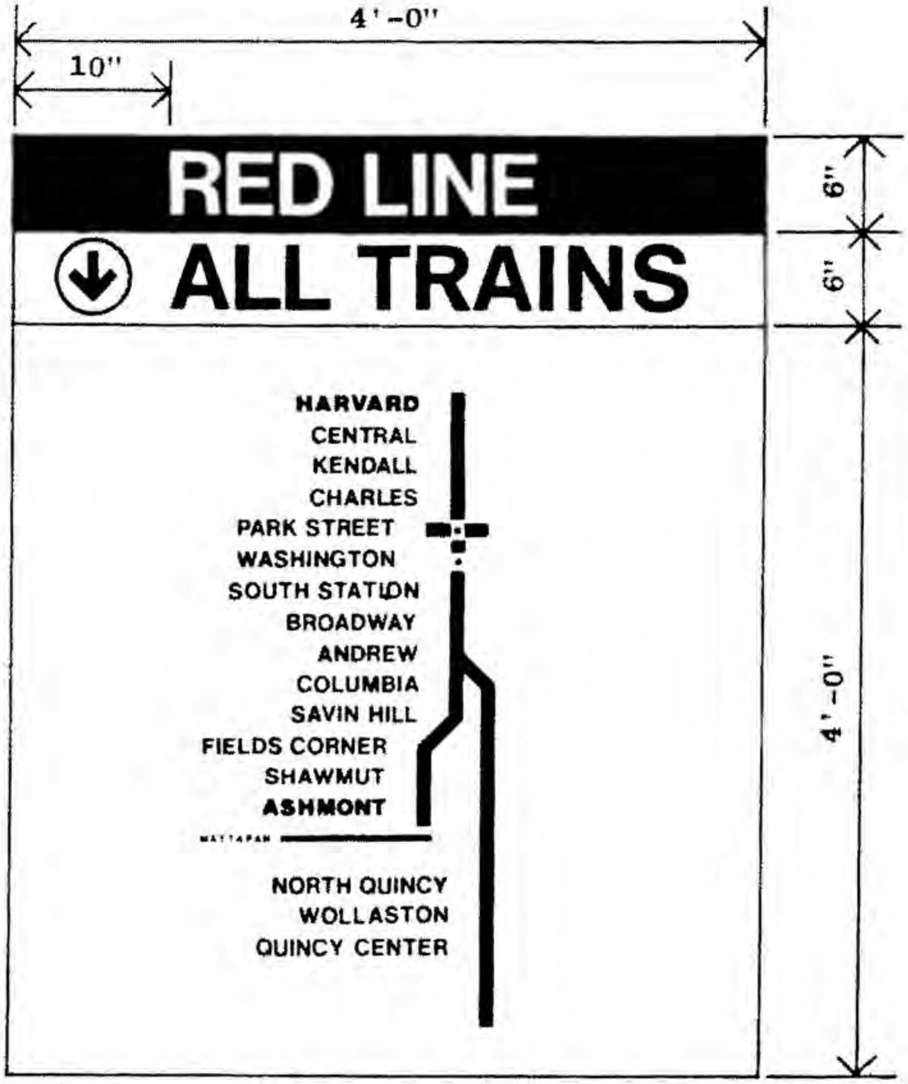


Sample Sign at Kendall Station Outbound

The List of Stations unit, when used at platforms, omits the 12" unit at the top. The 9" Identity Band carries the color of the Line, and the white 6" Information Band carries the 4" lettering of platform direction (Inbound, etc.) directly over the List of Stations.

At platforms an additional panel of white material, matching the sign and varying height is added to the bottom of the sign to fill in the full height between the upper and lower bands if lower band is used.

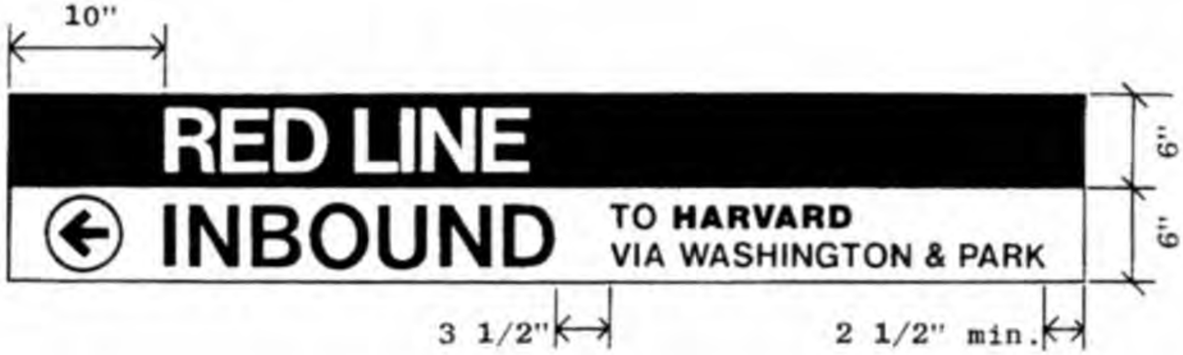
LIST OF STATIONS - OUTBOUND



This sign is used where there is insufficient wall space to accommodate separate signs for inbound and outbound, or where a passageway or stairway serves both directions.

A similar sign is used at Green Line surface stops where space and budget precludes the use of special signs for each stop or direction.

<u>LISTS OF STATIONS - ALL TRAINS</u>



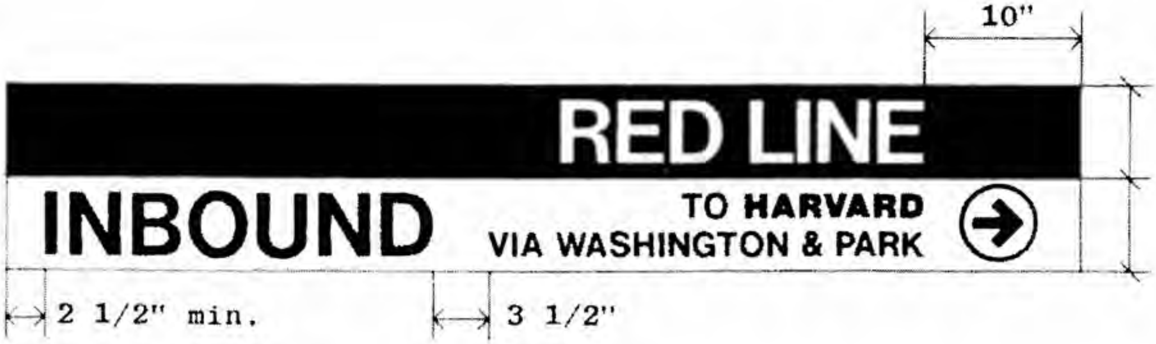
Use this layout where space is wide enough.

Use this layout only when space is too narrow. When space is narrow and headroom is limited, the color band with line name may be omitted.

Locate these units at all decision points as shown on F6.2. Wherever possible, incorporate them with List of Station signs.

A secondary function of the Line/Direction unit is to reinforce directional decisions already made, as for example in long corridors. Use these units repetitively at frequent intervals to provide reassurance. See F6.3.

LINE/DIRECTION SIGNS - BASIC UNITS



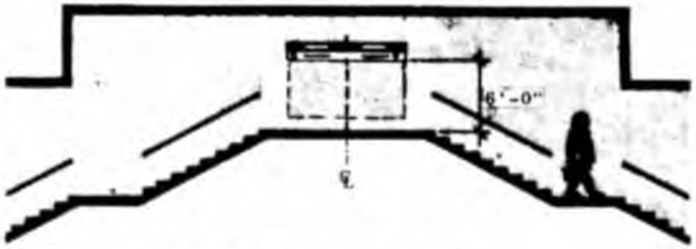
Layout for flush right location

Layout with single line of small text

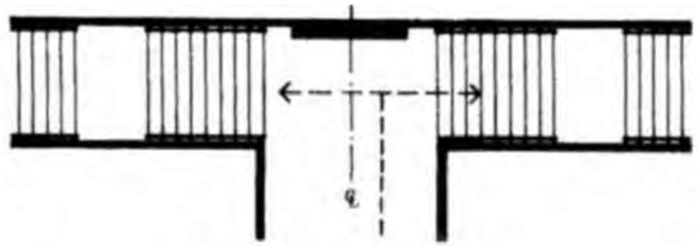
Layout when used with station identity band without List of Stations map.

Small text is 1 1/2" high, spaced 1" from top and bottom of 6" white band (flush with top and bottom of 4" text). Terminal name, "Harvard", is Helvetica Bold, all other text is Helvetica Medium.

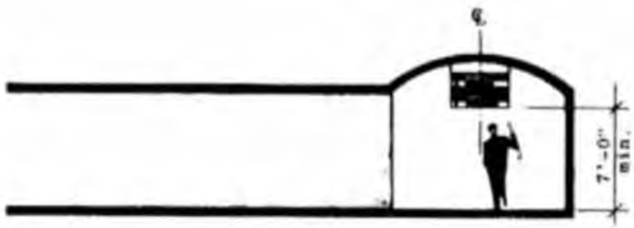
LINE/DIRECTION SIGNS - VARIATIONS AND DETAILS



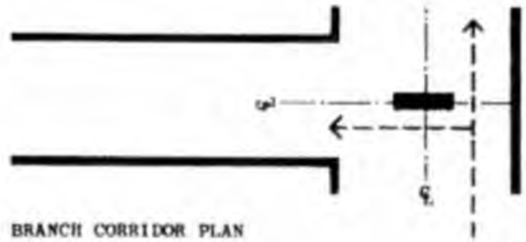
HEAD OF STAIR/END OF CORRIDOR ELEVATION



HEAD OF STAIR/END OF CORRIDOR PLAN



BRANCH CORRIDOR ELEVATION



BRANCH CORRIDOR PLAN

Use the Line/Direction signs at circulation decision points, where the choice of RTL and direction has already been made on the basis of List of Stations/Map units at entry and transfer points.

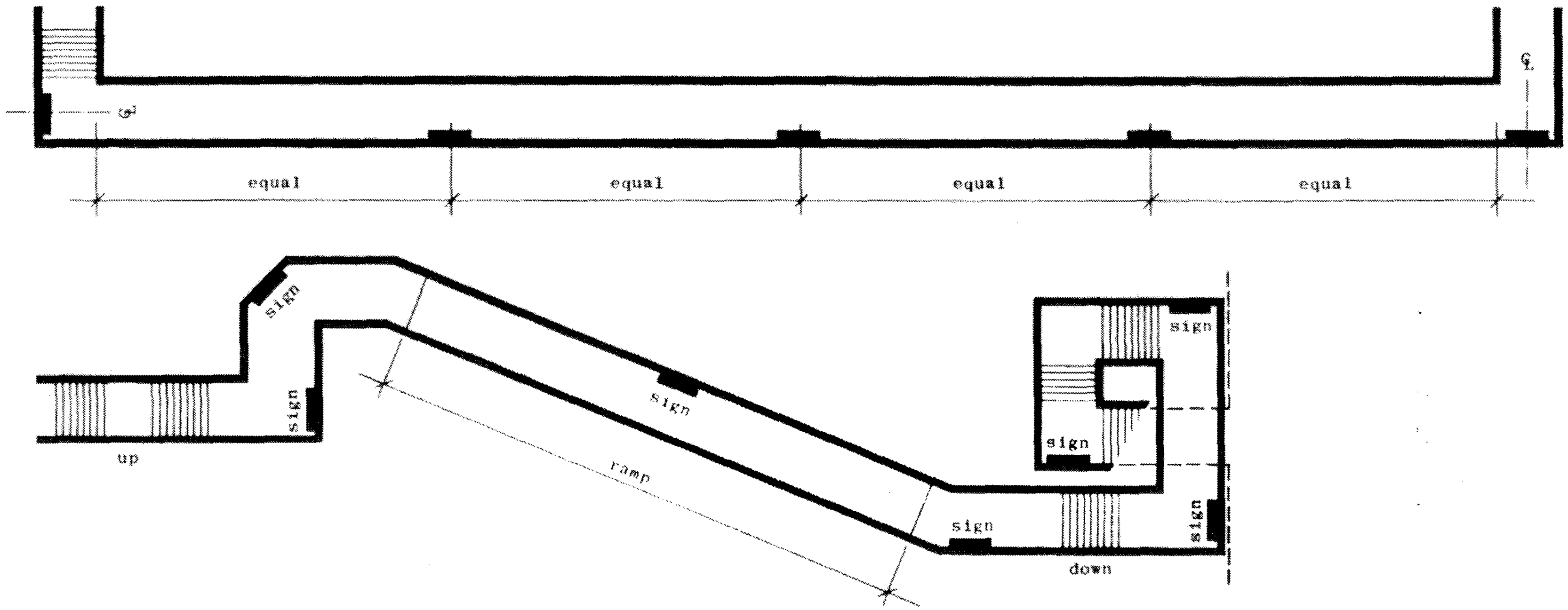
The signs should be positioned and the arrows oriented so that the choices are clear and not ambiguous. Show continuing circulation destinations as well as the branch circulation.

LINE/DIRECTION SIGNS - AT DECISION POINTS

See F6.1 for varying organizations of this entering and transferring information.

Use this directive at all choices, and wherever confusion and disorientation might occur.

Where circulation space permits, include the Directional List of Stations, with the Line/Direction unit. The List has been omitted here because in the upper example a passenger stopping to read it at the head of the stairs could cause congestion, and because in the lower example there is not adequate headroom.



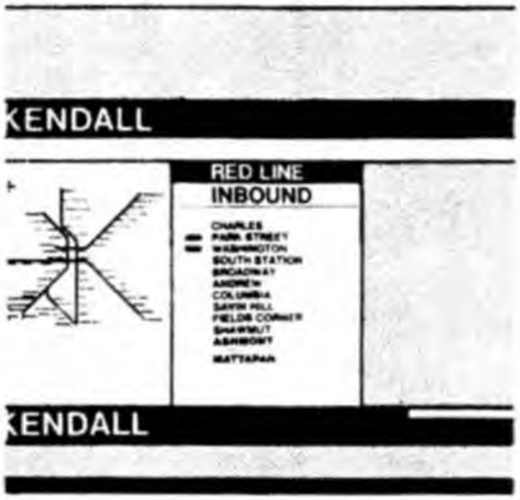
Use the Line/Direction sign to reinforce circulation.

In long passages and walkways, position the Line/Direction sign at close intervals (30' to 50') to reassure the passenger that he is going in the right direction, and to relieve the monotony of these spaces.

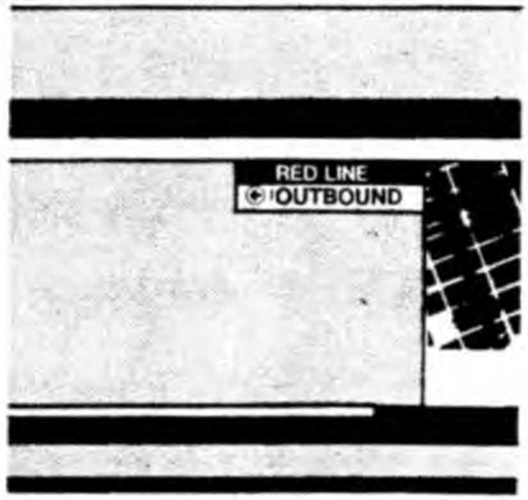
In devious passageways, with confusing changes in direction and/or many changes in level, use the Line/Direction sign to reinforce the circulation and to prevent disorientation.

For stacked combinations with exiting signs, performing the same reinforcement function in the reverse direction, see F6.1.

LINE/DIRECTION SIGNS - AS REINFORCEMENT

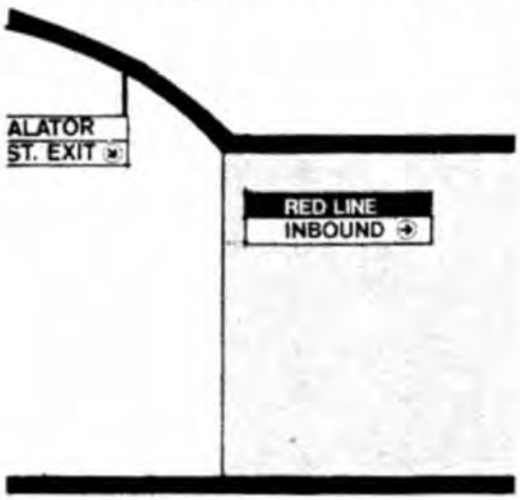


A

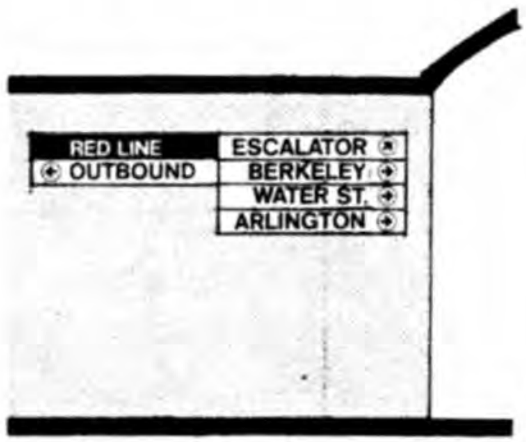


B

Do not use Line/Direction signs on top of List of Stations unit as a platform application (A). See F5.2. Do not use Line/Direction signs on platform walls (B). Transferring information should appear both in the Information Band (See G3.3) and perpendicular to platform (See G4.3).



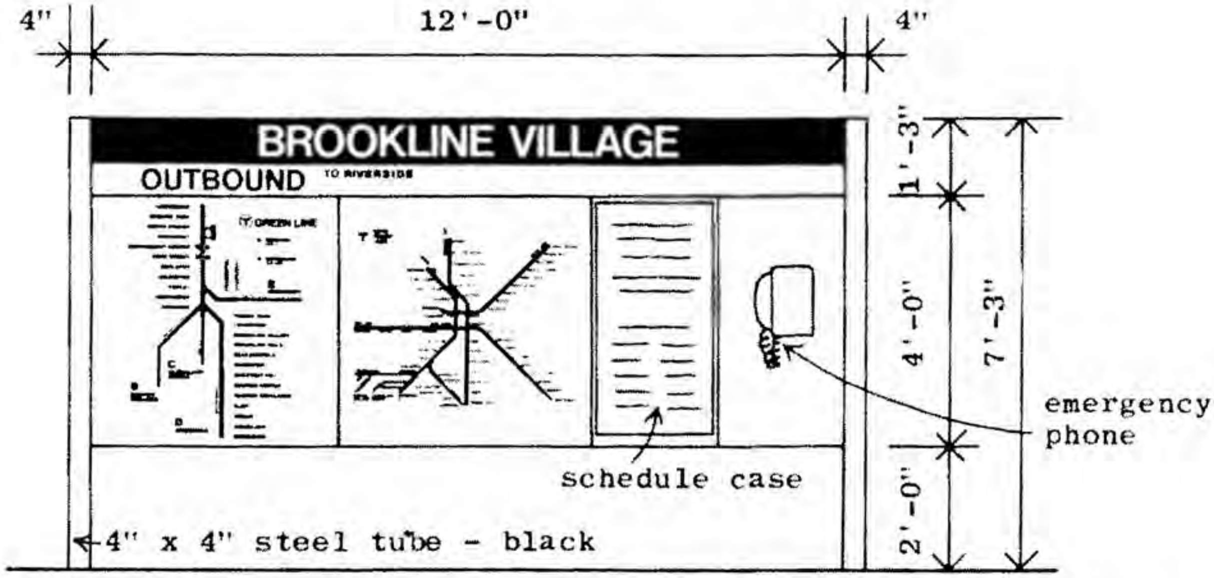
C



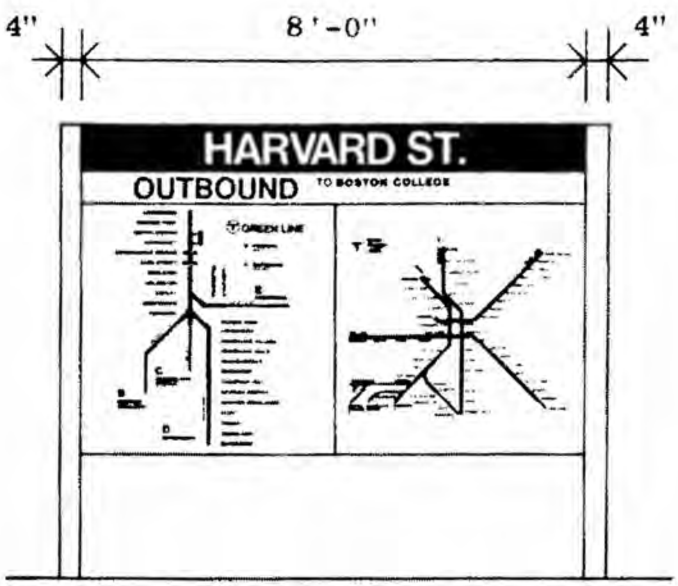
D

Do not position Line/Direction signs separately from other directional information which is nearby (C & D). Position all direction-giving information into combined units, with Entering and Transferring information on the top, and Exiting information on the bottom (See F6.4).

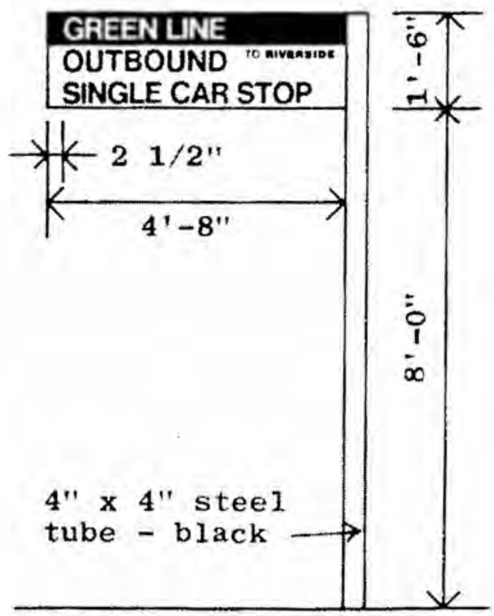
INCORRECT USES AND COMBINATIONS



Type A - 12' unit with maps, schedule case, and emergency phone
Type B - 12' unit with maps only
Type C - 12' unit with 1'-3" identity band and bench
Type D - 12' unit with 1'-3" identity band only



Typical 8' unit with maps



Stop Location Sign

SPECIAL SIGN AND MAP UNITS FOR GREEN LINE SURFACE PLATFORMS

Comprehension of the signing system, and of its application at stations, becomes clear if one traces all possible passenger routes and analyzes each decision point for the essential information required at that point.

This section of the Manual outlines the use of basic signing types encountered by the exiting passenger (some of which are also encountered by the transferring passenger).

The exiting sequence begins with the passenger's view of the station platform from the decelerating train, and ends as he leaves the station.

The same criteria that apply to entering signs apply also to exiting signs: maximum visibility and maximum simplicity. Nonessential information should not be included, and reference maps should not be located in narrow circulation areas. Copy on directional signs should be as short and clear as possible.

The neighborhood map, a unit that is of special interest to the exiting passenger, should be located together with other maps at the platform, at wide passageways and at fare collection lobbies. For combinations of map units see Section F.

Note that orientation photomurals, described in Section H, are in effect major graphic items at the beginning of the exiting sequence, seen in combination with the station name band from the decelerating train.

GENERAL DESCRIPTION

SIGN TYPE KEY

1. Upper and Lower Name Bands - Station Name

2. Information Band - Directional Signs - Opaque

3. Maps at Platform

4. Directional Signs - Exit and Transfer - Backlit

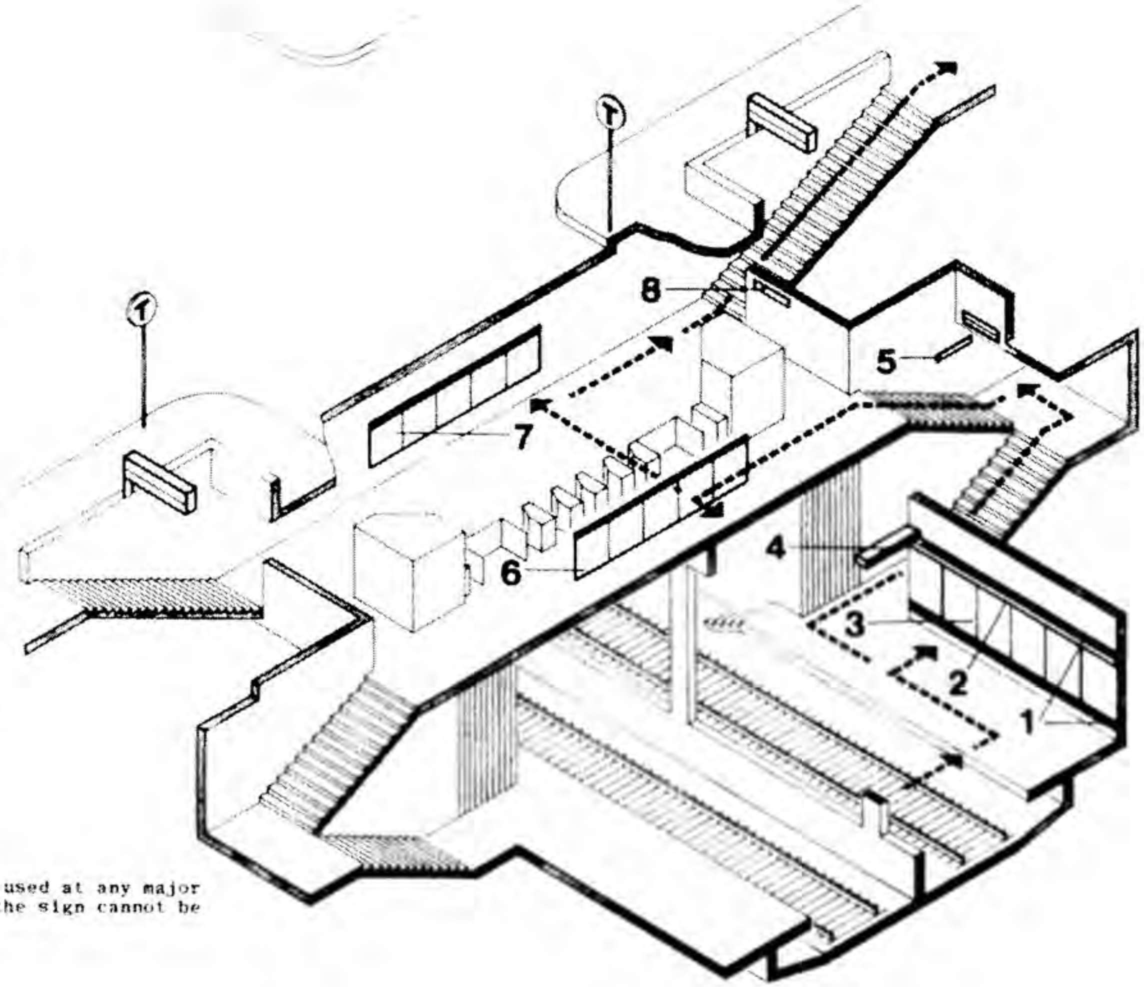
5. Directional Signs - Exit and Transfer - Opaque or Backlit

6. Maps Inside Fare Collection

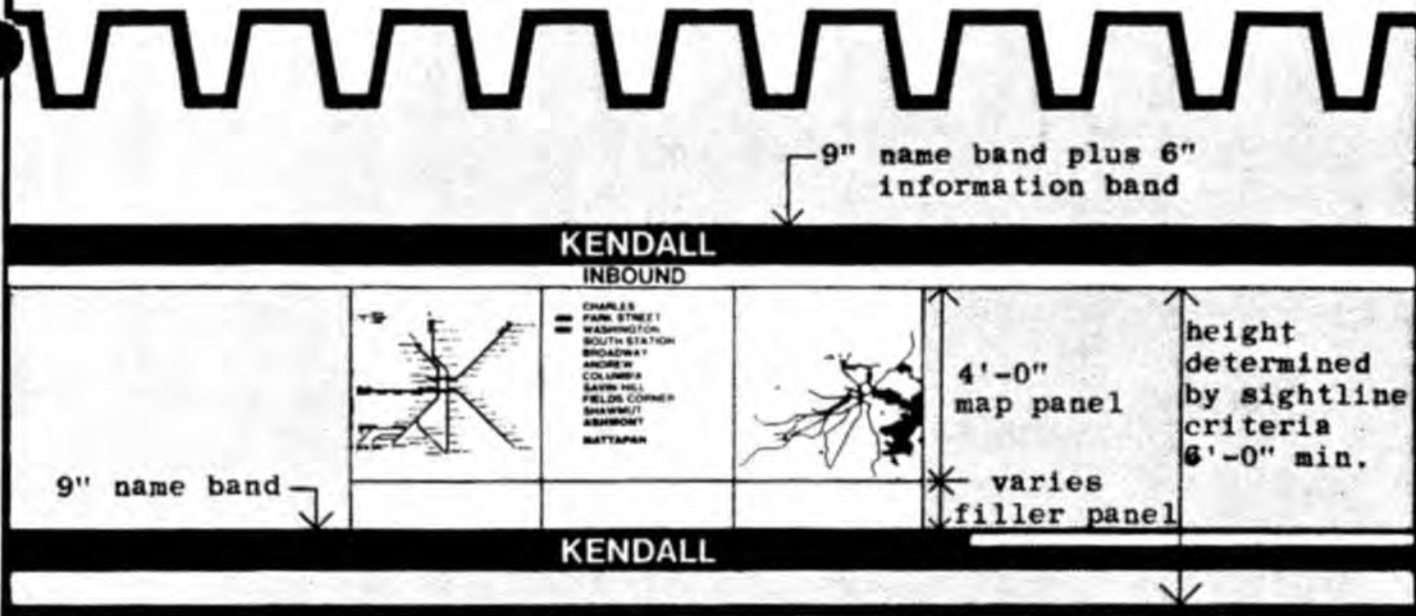
7. Maps Outside Fare Collection

8. Directional Signs - Exit and Transfer - Opaque or Backlit

Note: Backlit directional signs should be used at any major decision points where accent lighting for the sign cannot be adequately provided by other means.



DIAGRAMMATIC ILLUSTRATION - SIGN TYPES



ELEVATION OF PLATFORM WALL

Use the Upper Station Name Band at all stations. If desired, the lower band can be used intermittently occurring only at maps and photomurals. Where visibility of the upper band is adequate for persons onboard trains, the lower band may be omitted. The 9" name bands occur only on train and bus platforms.

At platforms where continuous wall surfaces do not exist, name bands may be intermittent, supported from the ceiling or by free standing structures. The station name must be visible from every car in a train.

Station name is centered in structural bays and occurs every bay or every other bay as shown in G2.1, 2.2. Locate the bands according to sightline criteria: I-D8.0, D9.0. Do not obscure the station name on the Lower Band with benches, etc.

NAME BAND/STATION NAME - USE

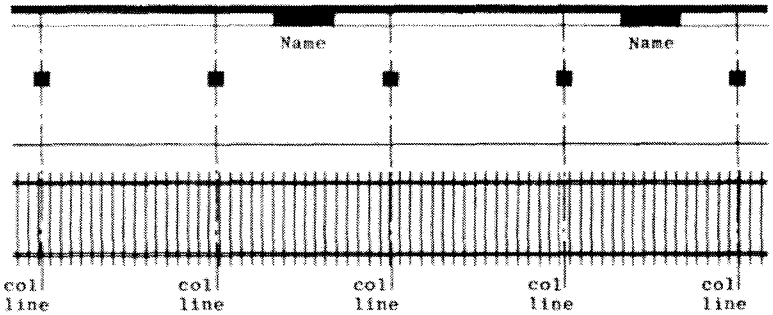
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MANUAL OF GUIDELINES AND STANDARDS
REVISED 1977

STATION EXITING SIGNS

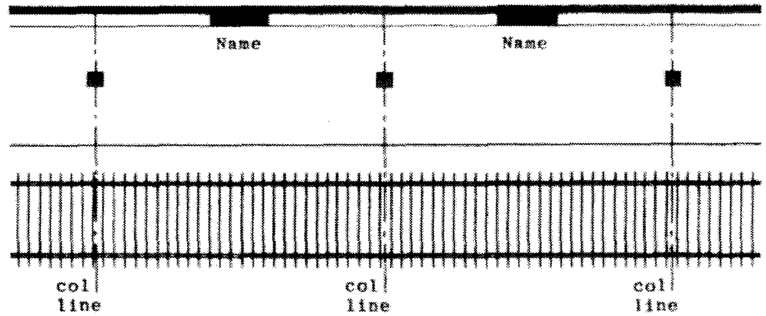
GRAPHICS

V

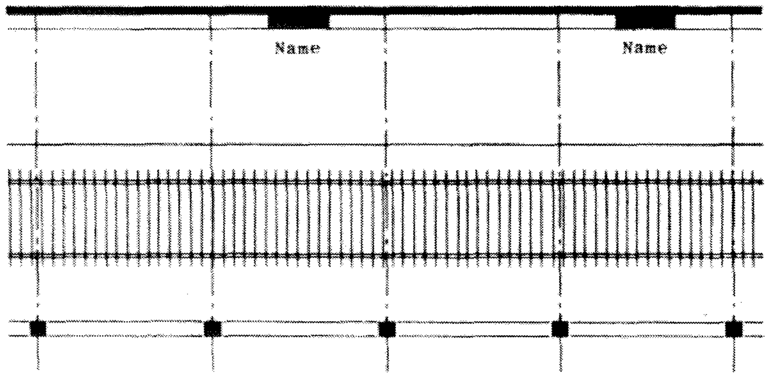
G2.1



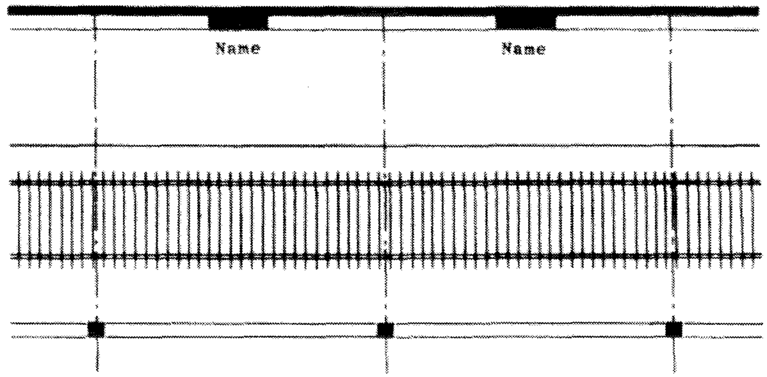
CLOSELY SPACED COLUMNS ON PLATFORM - 8'-16' o.c.



WIDELY SPACED COLUMNS ON PLATFORM - 17'-24' o.c.



CLOSELY SPACED COLUMNS BETWEEN TRACKS - 8'-16' o.c.

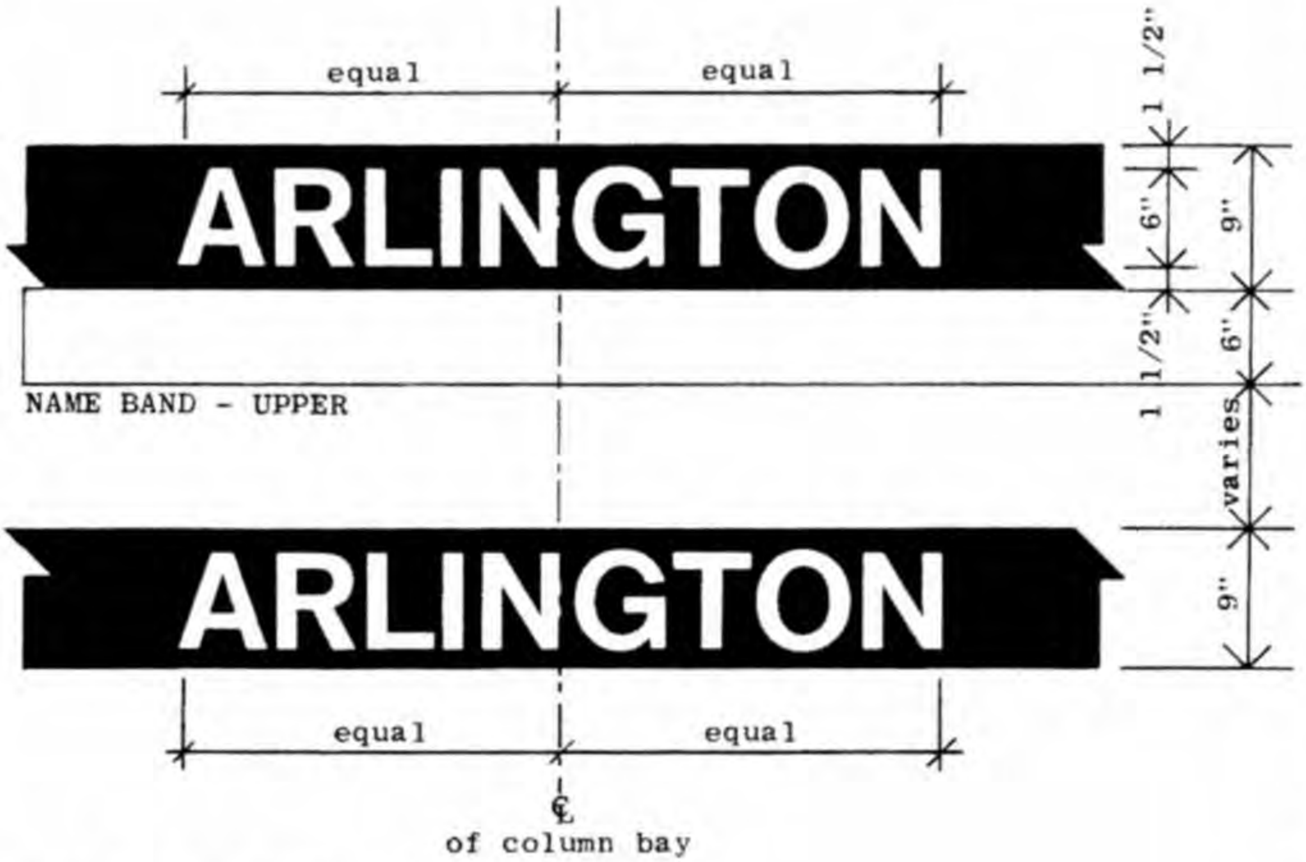


WIDELY SPACED COLUMNS BETWEEN TRACKS - 17'-24' o.c.

Use the above rules to locate the station name on upper and lower bands. See G3.0 for coordination of other graphic elements.

In stations where the structural bays are apparent, such as those with flat side walls, space the station names at 24' - 0" or 32' - 0" o.c.

NAME BANDS/STATION NAME - SPACING

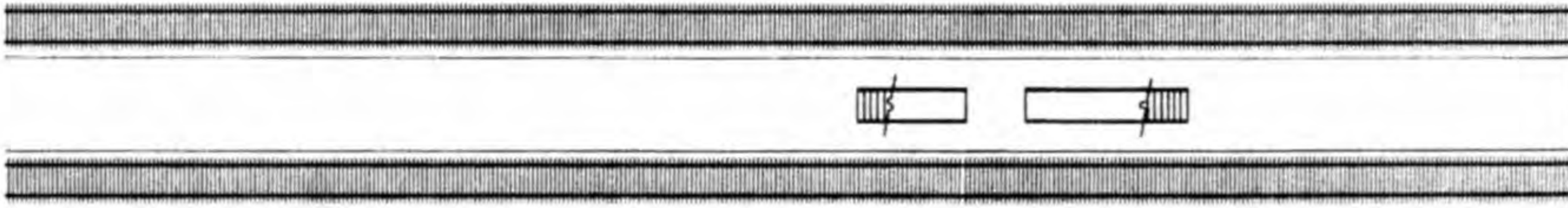


NAME BAND - LOWER (if used)

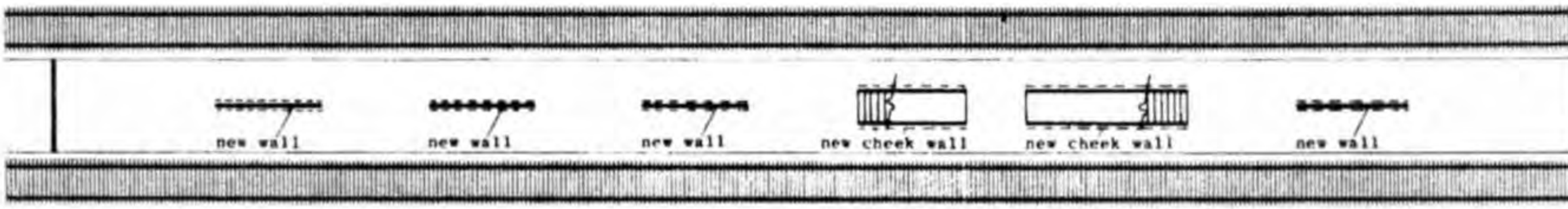
Station Name is 6" white lettering (see Section C for Authority Alphabet and Opaque Spacing Rules), on a 9" field of the color of the line (RTL Green, etc. See Section B).

Station Name is centered on the center-line of the structural bay. Use over photomurals and maps, when they occur. See G3.0.

NAME BANDS/STATION NAME - SAMPLE



SAMPLE PLATFORM - BEFORE

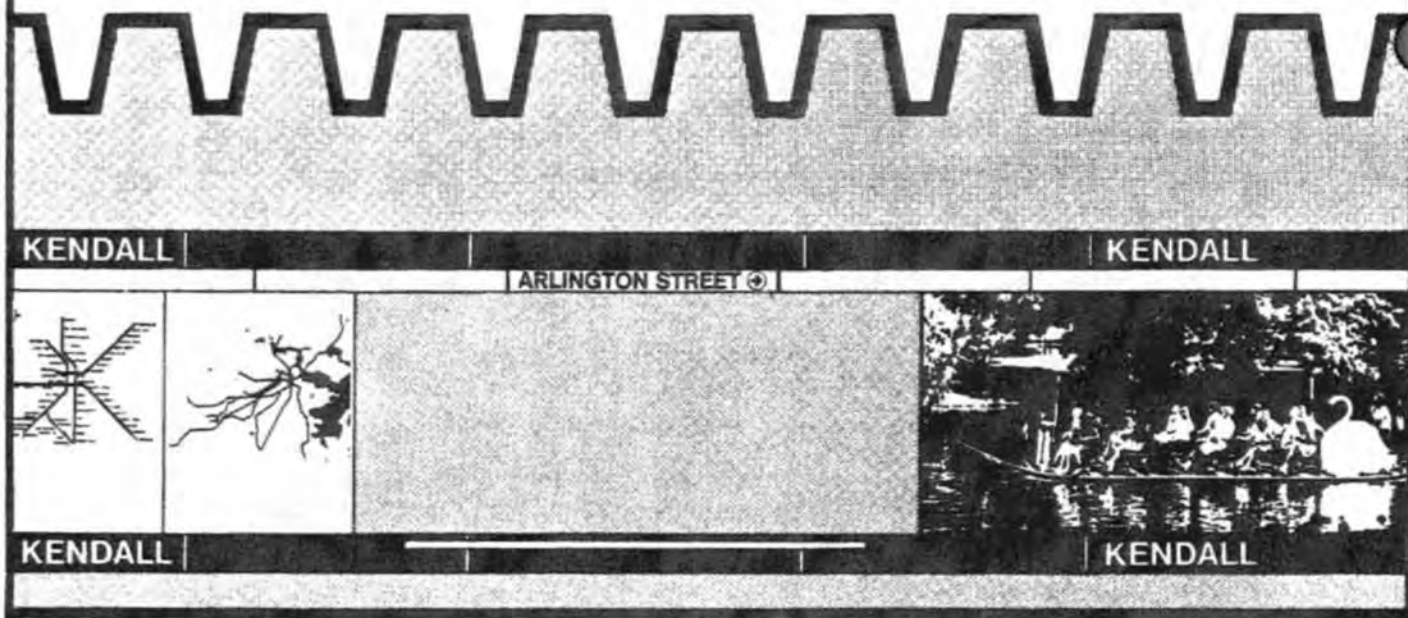


SAMPLE PLATFORM - AFTER

One of the most important goals of modernization is to achieve consistent orientation in relation to the full length of the train. The exiting passenger, disembarking at any point along the full length of the platform, should be able to see immediately the station name, and read directional exiting information. If possible, and particularly in underground stations, he should at the same time be able to see a recognizable orientation photomural that reinforces the station's identity (see Section H).

NAME BANDS - LINEAR CONTINUITY

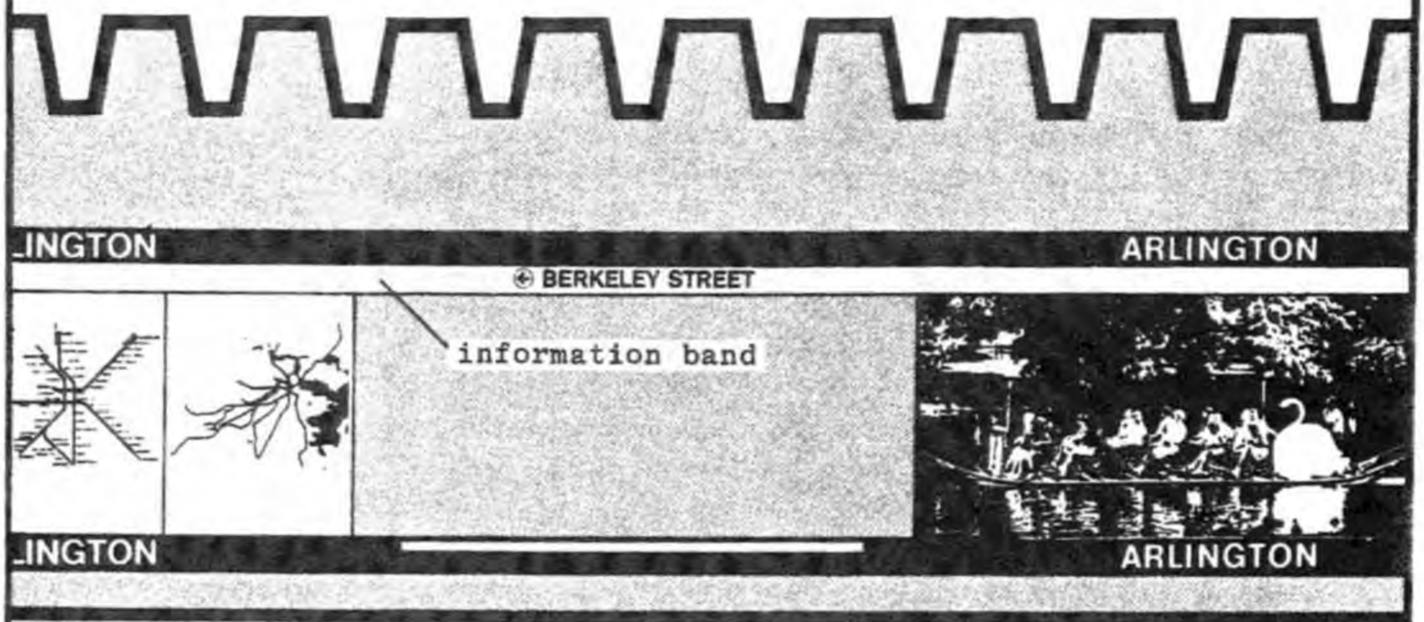
Platforms that have long open areas without adequate graphic surface therefore need additional wall surface. New free-standing walls, floor to ceiling partitions and cheek walls next to stairs should be constructed as indicated in this example (See also Part I). Relate new walls to the structural system, in a manner similar to the station name spacing. See G2.1.



Do not allow porcelain enamel joints, which are of necessity quite visible, to occur between letters or closer than 2½" to either end of any sign unit. (See also G5.0).

For fabrication and installation details, see Section VII.

<u>NAME BANDS - PORCELAIN ENAMEL JOINTS</u>

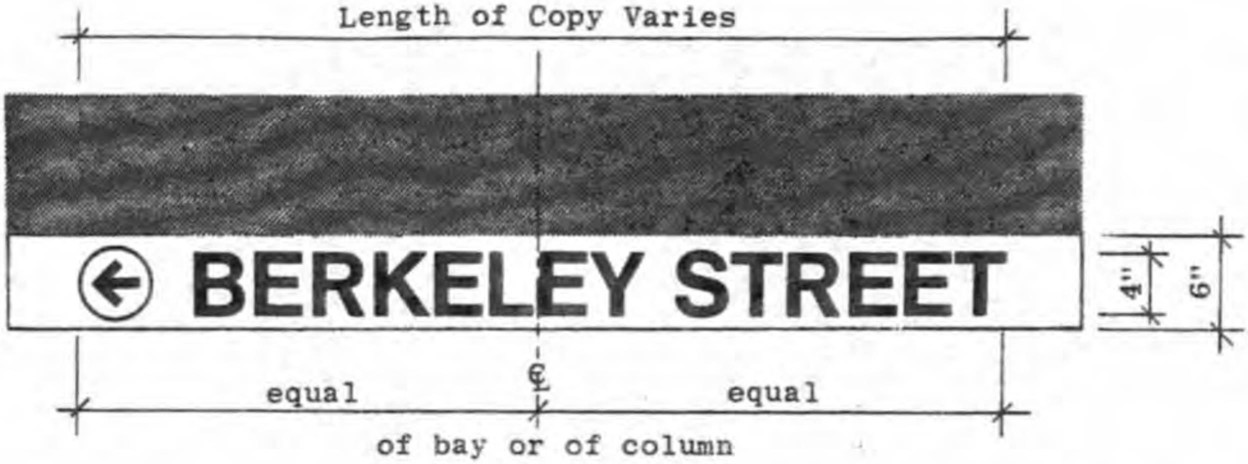


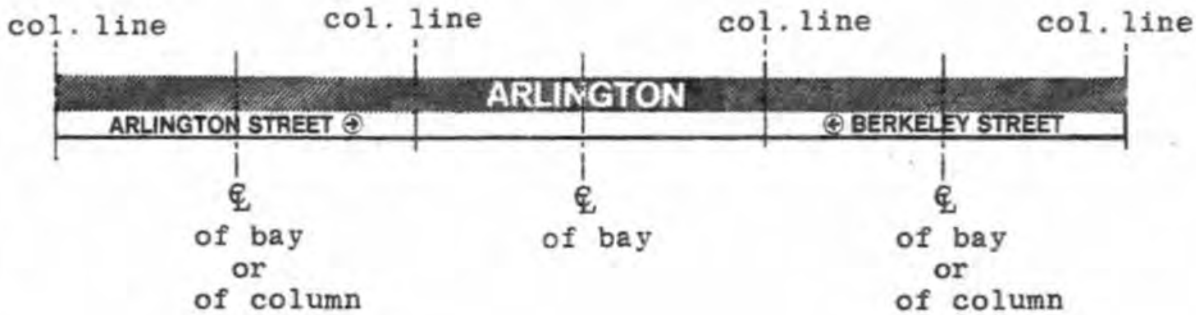
Use the Information Band (the white part of the Upper Name Band) exclusively for directional information: direction over station lists ("Inbound"; "Outbound"; "Southbound"; etc. - See F4.2, 4.3, 4.4) and exiting and transferring instructions.

The Information Band should only be interrupted where necessary, such as over doorways. The colored part of the top Band should continue without interruptions wherever possible (See G3.2).

Signs within the Information Band must be centered between the Station Names. Do not place directional signs over photomurals, unless absolutely necessary.

INFORMATION BAND - BASIC USE





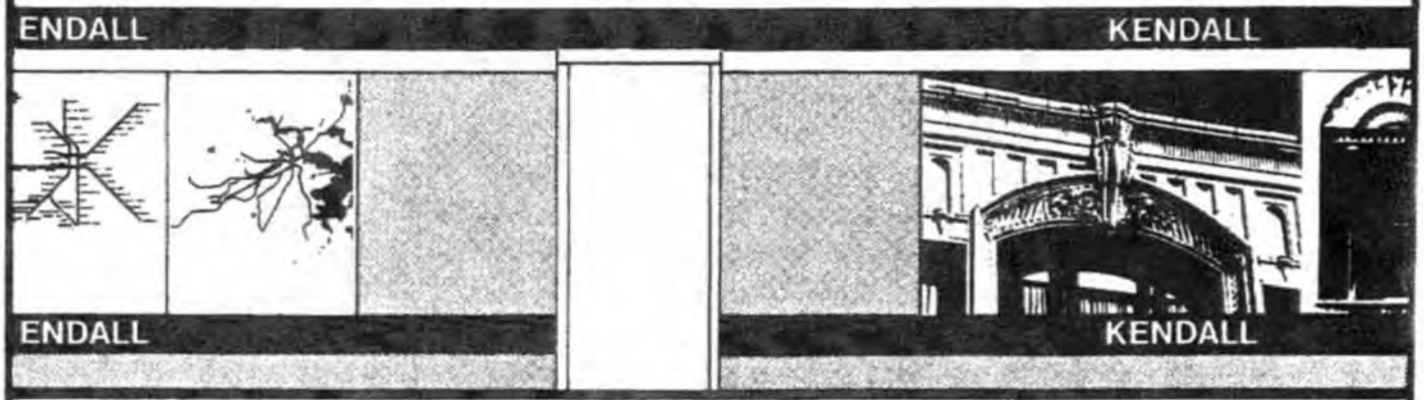
Information Band is 6" white porcelain enamel or polyvinal-fluoride with 4" black lettering. For alphabet, spacing rules, and uses of arrow, see Section C.

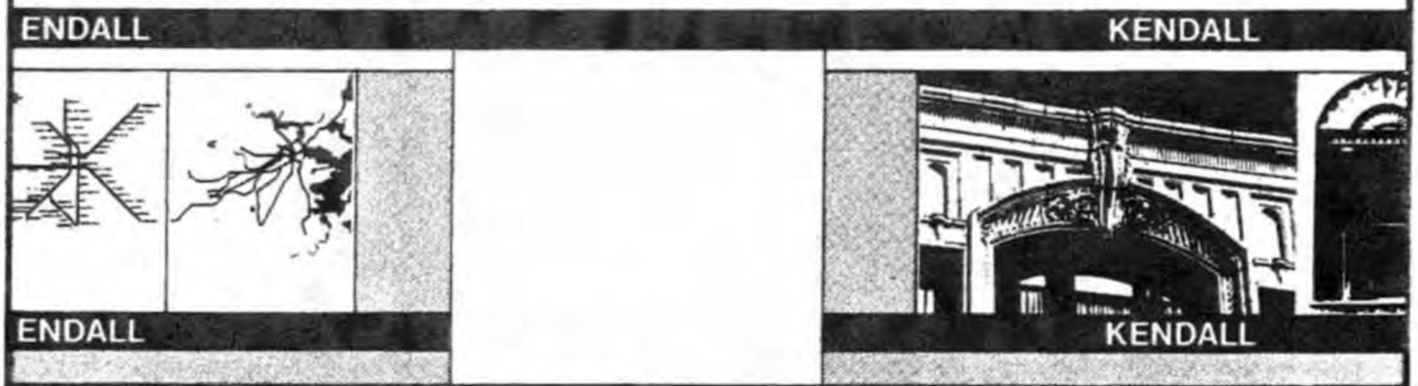
Directional signs are located midway between Station Names. Avoid locating Directional Signs under Station Names wherever possible.

As shown on G2.1, directional signs may occur halfway between closely spaced columns, or at the center line of widely spaced columns.

Keep copy of signs simple and brief for maximum clarity.

INFORMATION BAND - SPACING OF DIRECTIONAL SIGNS





The Information Band may be interrupted if necessary, for example over doorways or recesses where headroom may demand it. The colored part of the Upper Band, however, should continue at all times as shown above.

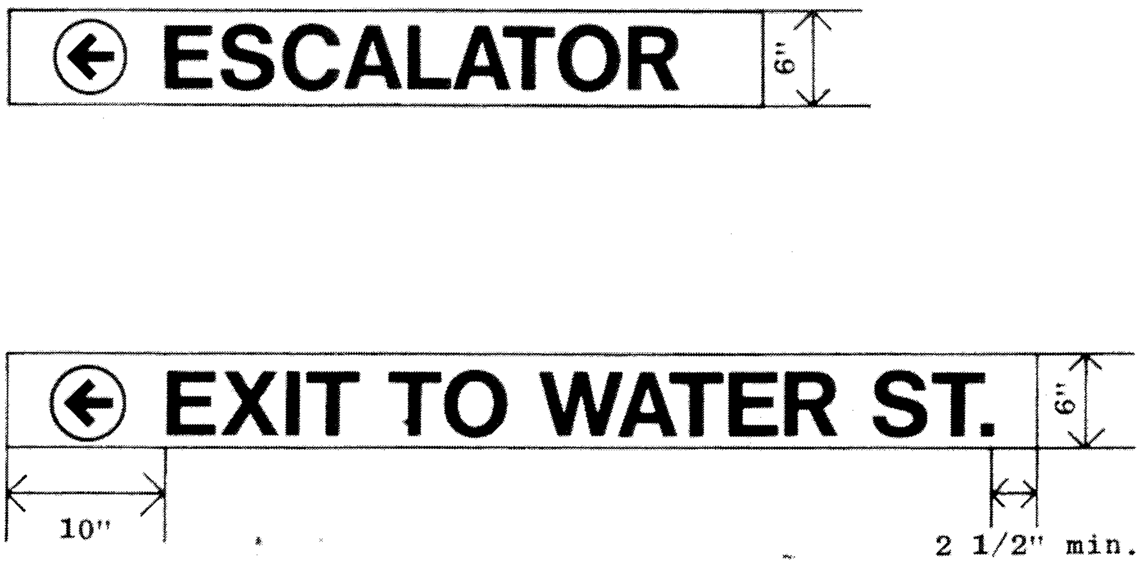
INFORMATION BAND - NECESSARY INTERRUPTIONS

white letters, orange field

black letters and arrow, white field

If at a special location the Information Band must be used for a line transfer sign, because a 12" Line/Directional sign (see F6.0) cannot be located nearby, or in an adequately visible nearby position, the lettering must be black. Do not use colored lettering in the white field.

INFORMATION BAND - LINE TRANSFER USE



The above units are the basic modular components of all directional signs and are to be used at all decision points. They are used either singly, as shown above, or in stacked combinations, as shown on F6.1 and G4.2.

The four foot length is preferred, so as to coordinate with standard map units, but larger lengths of even one foot increments may be used when required for copy fitting. Note that sign copy must not be closer than 2½" to the ends of the signs. Signs of odd lengths should only be used where special architectural conditions dictate, such as suspended illuminated signs spanning exactly between walls.

Sign copy is laid out according to the Authority's alphabet and spacing rules (See Section C), with 4" black letters on a 6" white field.

<u>DIRECTIONAL SIGNS - DETAILS</u>

STANDARD BACKLIT SIGN UNIT
(black lettering white background)

Use Backlit Directional Information signs to identify major circulation elements. Backlit signs follow standard height proportion rules of 2 to 3, lettering to background, and backlit copy fitting requirements. See Section C, especially C8.1. Note that the 6" white background is surrounded by a 1/2" black frame, increasing the standard dimensions by 1" in both directions.

SPECIAL BACKLIT SIGN - SWITCH-OFF SECTION
(white lettering black background)

This special sign is only to be used when the station layout and operation demands a separately switched section of the sign.

Note that the lettering for this sign is applied to the inside of the face, and that the front acrylic sheet for this sign face is tinted gray (approximately 20% light transmission) so that the word "CLOSED", when shut off, is almost invisible through the surface of the sign.

DIRECTIONAL SIGNS - BACKLIT

To combine two sign units, establish reference margin on whichever side of sign is required by the arrow conventions, and set lettering to it. See Section C. Separate sign units with 1/4" black stripe centered on the joint between them. Run the black stripe the full width of the sign.

Position reference margins so that no type overlaps the reference margin of the sign above or below it. See Section C.

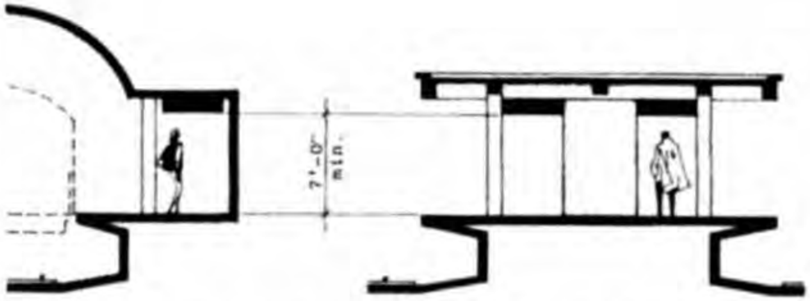
Use 6" black band to separate Line/Direction Signs from other Directional Signs.

STACKED COMBINATIONS

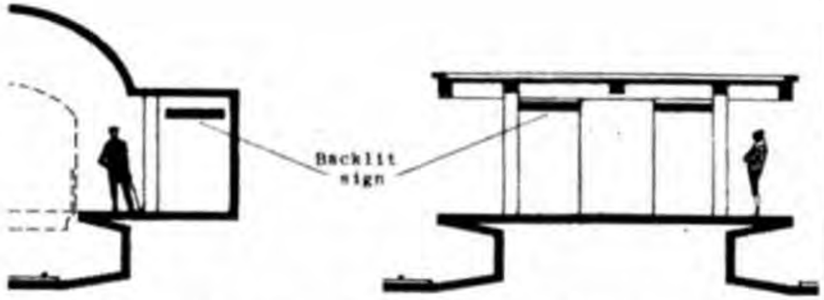
Exiting Directional Signs often occur in combination with Entering and transferring information. In these cases the exiting signs must be located on the lower part of the sign, with entering signs given precedence on the top. See C7.0-9.1 for Arrow/Circle spacing, and directions.

Use exiting signs at all decision points and for reinforcing exiting circulation. See similar applications on F6.3 and 6.4. The same units along passageway walls that reinforce entering circulation should be used to reinforce exiting circulation.

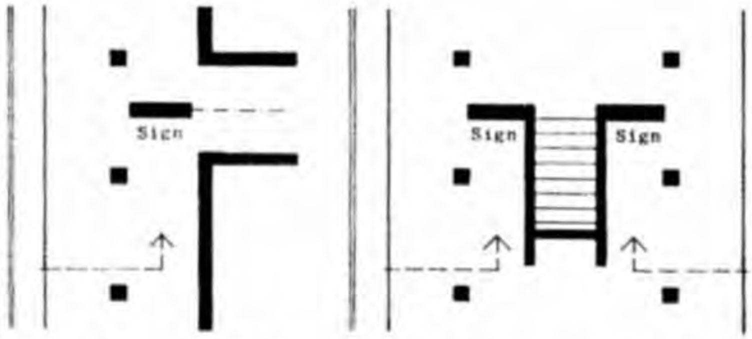
<u>DIRECTIONAL SIGNS - STACKED</u>



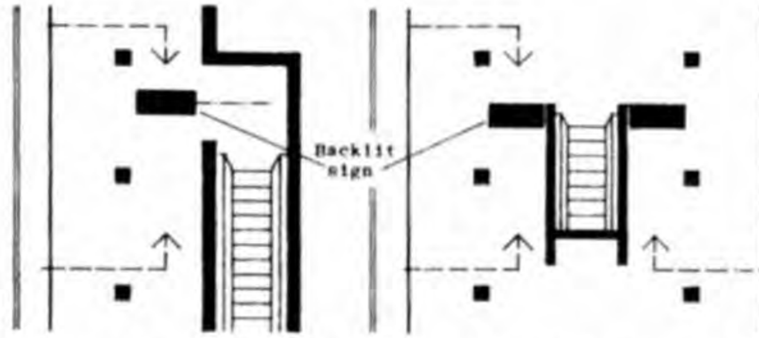
SIGN AT PASSAGEWAY - ELEVATION   SIGN AT STAIR - ELEVATION



SIGN AT ESCALATOR - ELEVATION   SIGN AT ESCALATOR - ELEVATION



SIGN AT PASSAGEWAY - PLAN   SIGN AT STAIR - PLAN



SIGN AT ESCALATOR - PLAN   SIGN AT ESCALATOR - PLAN

These signs are the primary signs in the exiting sequence, designed to identify passageways, stairs, and escalators for the passenger who has just disembarked from the train.

Back-illumination will be required in almost all cases for accent purposes, since these signs are often two-sided, perpendicular to the linear platform lighting and therefore difficult to externally accent without creating dangerous glare. For fabrication details see IV-D5, D5.1.

DIRECTIONAL SIGNS - PERPENDICULAR TO TRAIN - BACKLIT AND OPAQUE

Note that the field height of these signs is always 6" or a combination of 6" strips exclusive of the frame dimension.

Use Backlit sign with blank-off option when stairway, entrance, etc. is sometimes closed. See IV-D5.3. Unlike all other signs, these signs must use white letters on a black field.

Use Backlit Directional Information sign perpendicular to circulation flow to identify major circulation elements and choices - escalator, trolley, transfer, etc. See IV-D5, D5.1.

DIRECTIONAL INFORMATION - PERPENDICULAR/BACKLIT

Do not put borders around the Station Name. Do not use the Identity Bands discontinuously where the platform wall continues.

Do not allow porcelain or film joints to fall within words. Where possible, do not allow joints to fall between words of a single sign.

Do not change the size of the Identity Band. Do not use the 9" Identity Band for copy other than Station Name. Do not locate information other than Station Name or RTL Line Name within colored fields.

INCORRECT USES AND COMBINATIONS

Underground stations that lack open views to the neighborhood are particularly in need of a strong individual identity, which cannot be adequately given by Station Name bands or minor variations in architectural structure, finishes, or various details. It is necessary to give strong and meaningful variety to the transit system and establish for each station a "sense of place".

In the first stations modernized by the Authority, the photomural system has played a vital role in the station design and is particularly important in underground station platforms. This concept has been developed to establish or to reinforce the special identity of each station. The subject matter for each photomural has been drawn from the neighborhood surrounding the station in which it appears. Since their images are photographic and therefore recognizable reflections of each station's neighborhood, the photomurals are more than decorative. They visually tell the passengers, as they arrive by train at the station, where they are.

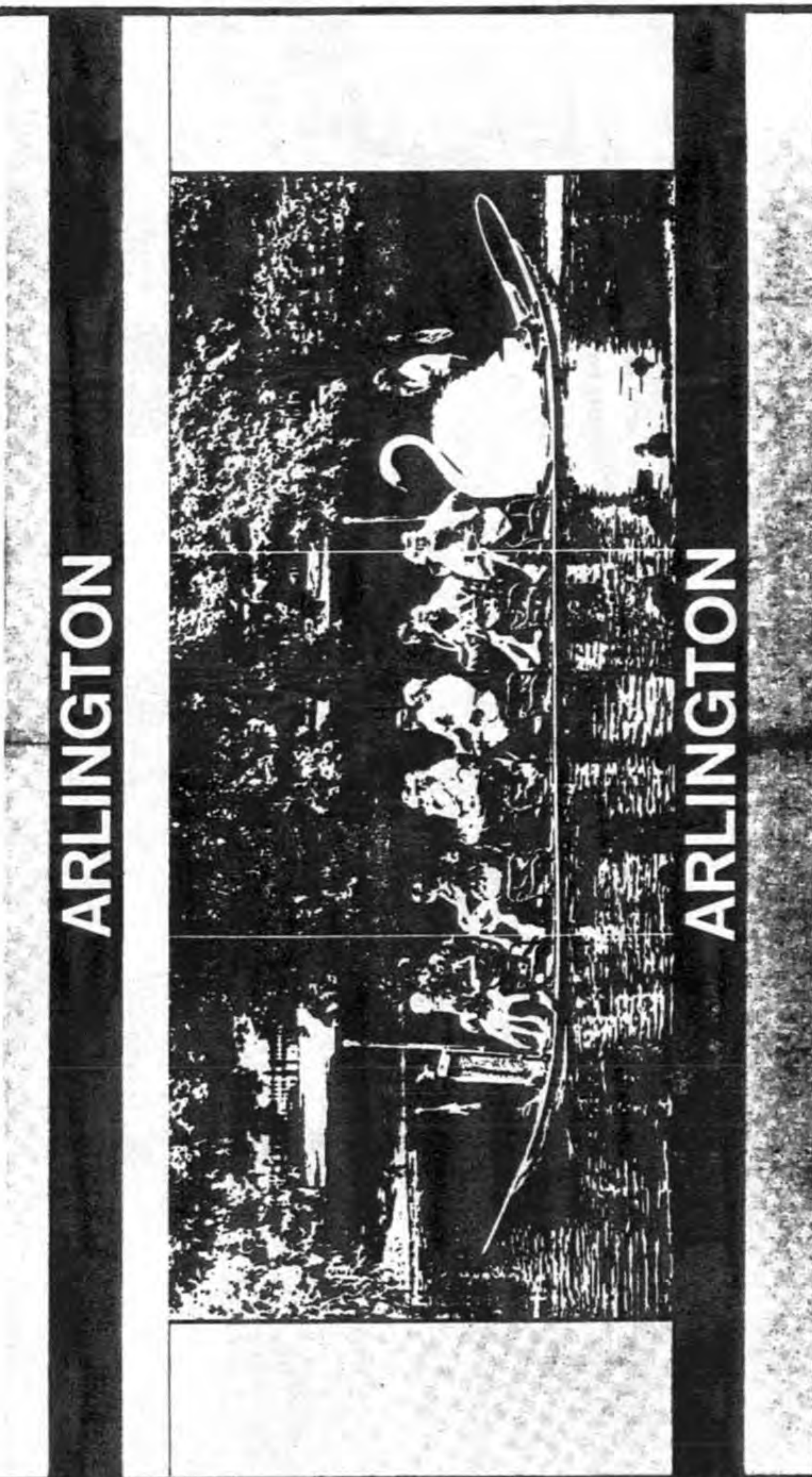
In a number of instances the neighborhood of the station was undergoing radical physical changes and it was necessary to substitute copies of old prints or other symbols to visually relate the station to its surroundings. An example is baseball tickets used at Kenmore.

Experience has shown that it is possible to establish the station identity for persons onboard the trains, as well as giving those waiting on the platforms a pleasanter environment, with the aid of more abstract forms of public art, including murals and sculpture.

Photomurals or drawings normally have been distributed linearly along the platform to maximize their impact. As trains move through the station, it is also possible to concentrate the work at one, or a few high impact locations. An example is the steel sculpture at the entering end of the Essex outbound platform.

The use of public art in other areas of the station is useful in establishing "landmarks" which help to orient the users, as well as improving their environment. An example is the train picture at North Station entry.

General Description



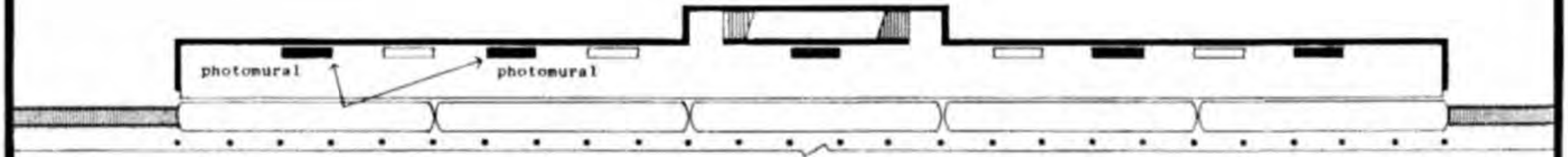
Locate photomurals on platforms, between Station Name Bands.
Divide porcelain enamel into three equal panels as shown.

TYPICAL PHOTOMURAL

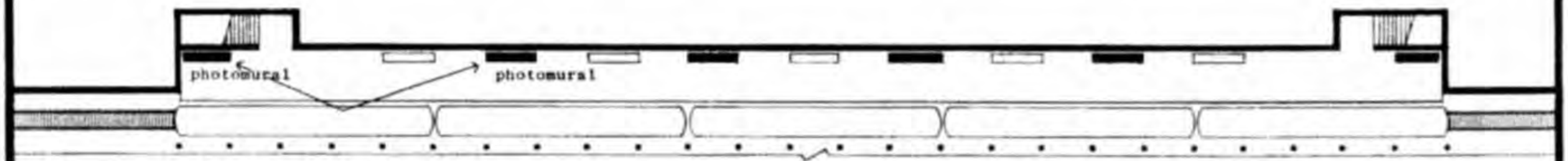
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

MANUAL OF GUIDELINES AND STANDARDS

REVISED 1977



PLATFORM - CENTRALLY LOADED



PLATFORM - END LOADED

Photomurals should be distributed with linear continuity throughout each station. Note that a passenger sees the stations in succession from his constant location within the train. In order for each station to have a strong identity, every passenger should see a photomural, regardless of his seat position. The photomurals should therefore occur along the full length of the platform.

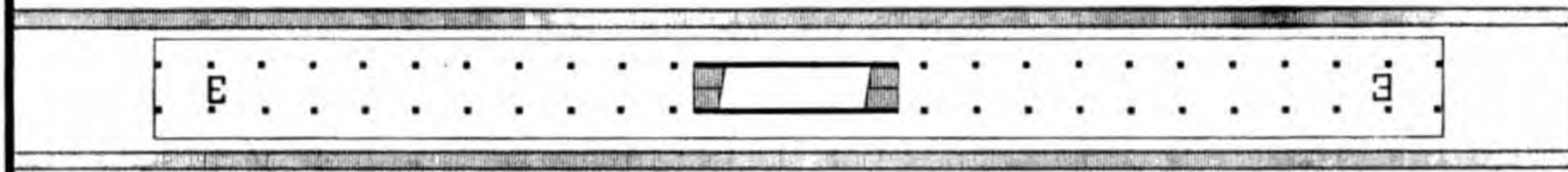
LINEAR CONTINUITY - RELATIONSHIP TO TRAIN

GRAPHICS

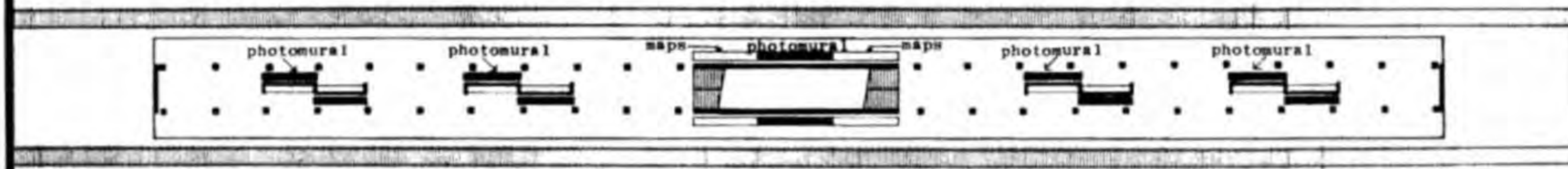
PLATFORM PHOTOMURALS

V

H3.0



PLATFORM WITH MINIMAL WALL SURFACE



PLATFORM WITH WALL SURFACE ADDED FOR LINEAR CONTINUITY OF GRAPHICS

Stations with minimal wall surface opposite arriving passengers require the construction of additional walls for maps and photomurals.

These walls should be so located that they do not block circulation or the visual openness of the station. The walls should also include upper and lower station name bands and cantilevered benching.

The walls must be distributed along the full length of the platform so that passengers alighting or viewing from all points along the length of the train will be exposed to them.

LINEAR CONTINUITY - WALL CONSTRUCTION

This section describes a variety of signs and markings required at stations and on diverse equipment. Many of these signs are standard Authority units, and will be stockpiled for use in all stations. Miscellaneous signs not shown here will become repetitive standard units and be described in new manual pages. Other signs will be single units only, and should be worked out by architects or Authority staff using manual prototypes as guidelines.

Note that all signs tend to have these features in common:

a) Helvetica medium all caps.

b) Black lettering on white background. Special signs use white lettering on black background, yellow lettering (warning) and red lettering (emergency).

c) Photo silk screen reproduction from camera-ready artwork, or direct fabrication of signs using precut letters.

d) Minimum changes of lettering size within each sign.

e) Lines of copy set flush left.

f) No printed borders around signs. Note that background color always bleeds to the edges of the sign.

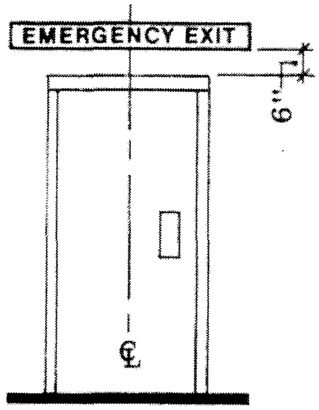
g) Minimum copy, for clarity and legibility.

GENERAL DESCRIPTION AND GUIDELINES

EMERGENCY EXIT

SIGN - 1/16 FULL SIZE

Lettering size:	4"
Color:	Red letters on white background.
Artwork:	Standard Authority Unit



ELEVATION - DOOR

Application:	Back-lit sign, mounted on wall above or beside door. Include Arrow/Circle if sign must be remote from door.
Material:	See Part IV for sign details and materials.
Illumination:	Must be on emergency circuits.
Use:	Sign should be used with Emergency Exit doors whenever possible.

EMERGENCY SIGNS - "EMERGENCY EXIT" BACKLIT SIGN

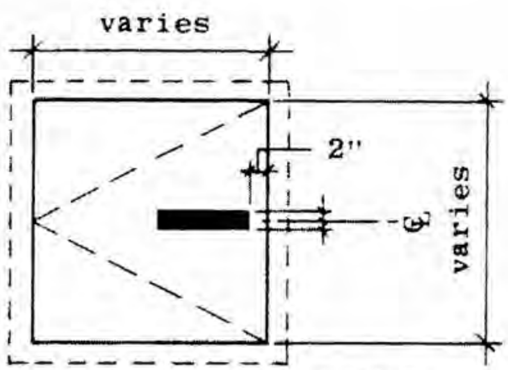
FIRE HOSE

SIGN - 1/2 FULL SIZE

Lettering Size: 1"

Color: Black

Artwork: Standard Authority Unit



FIRE HOSE CABINET DOOR

Position: 2" from edge of opening (unhinged) side of door.

Application: Silk-screened directly onto stainless steel, painted steel, or bronze door front.

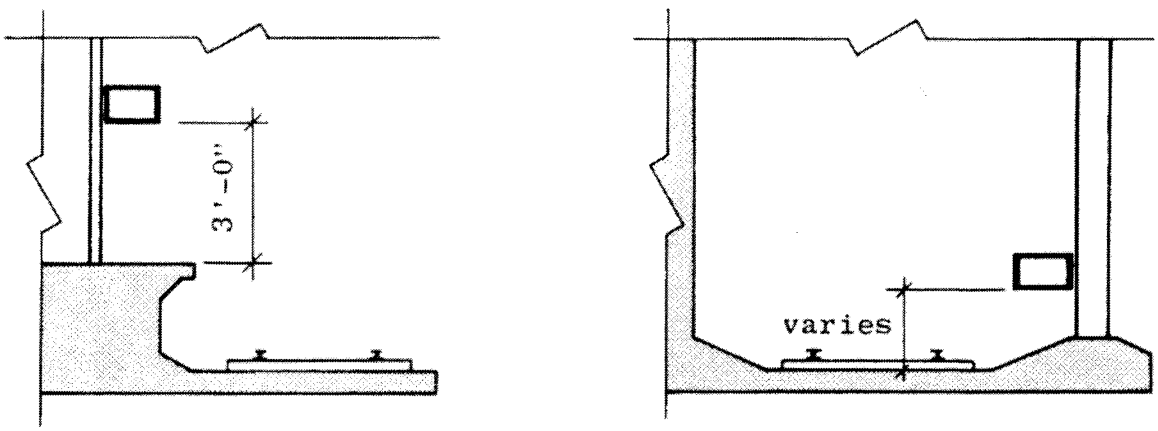
Material: Acrylic silk-screen ink.

Use: Sign appears on face of all fire-hose cabinets.

EMERGENCY SIGNS - "FIRE HOSE"

SIGN - 1/4 FULL SIZE

Lettering size:	2"
Sign size:	1'-3" x 10"
Color:	Black on white
Artwork:	MBTA standard unit



ELEVATION - PLATFORM END WALL

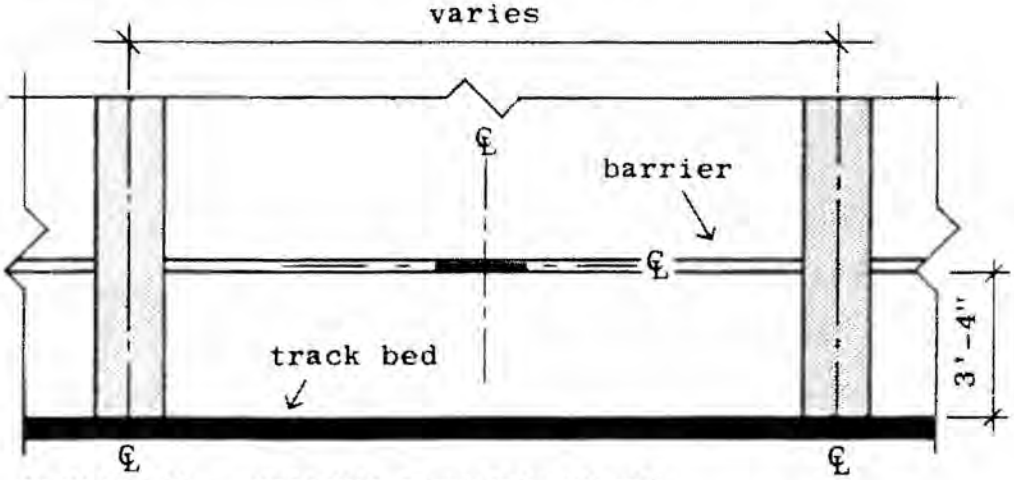
Position:	Flush with the end wall.
Application:	Install holder and sign.
Material:	Porcelain enamel.
Use:	At the end of all RTL station platforms and bus loading areas.

WARNING SIGNS - "DANGER NO PASSING"

KEEP BACK OF YELLOW LINE

SIGN - 1/8 FULL SIZE

Lettering size:	2"
Color:	Yellow on black or dark gray
Artwork:	Standard Authority Unit



ELEVATION - COLUMNS BETWEEN TRACKS

Position:	On Green Line barriers, and on walls and barriers across from bus loading areas.
Frequency:	Along the full length of loading areas, one every structural bay, or every 20'.
Application:	Silk-screened directly onto painted steel or concrete.
Material:	Acrylic silk-screen ink.
Use:	Between tracks and bus lanes.

WARNING SIGN - "KEEP BACK OF YELLOW LINE"

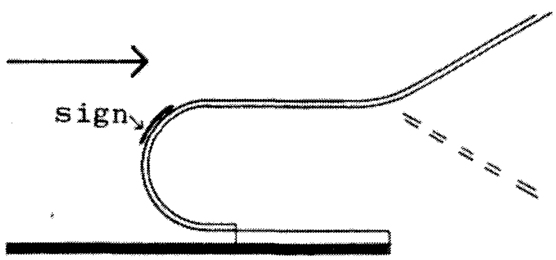
**DO NOT
PLACE
UMBRELLAS,
SUITCASES,
OR
OTHER
ARTICLES
ON THE
ESCALATOR.**

SIGN - 1/2 FULL SIZE

Sign Size: $5\frac{1}{2}$" x $7\frac{1}{2}$"

Color: Black letters on stainless steel.

Artwork: Standard Authority Unit



ELEVATION - ESCALATOR

Application: Bend to curve of newell, fasten with adhesive.

Material: Baked enamel letters on stainless steel, No. 4 finish.

Use: Sign appears at the entering end of all up and down escalators.

WARNING SIGNS - ESCALATOR

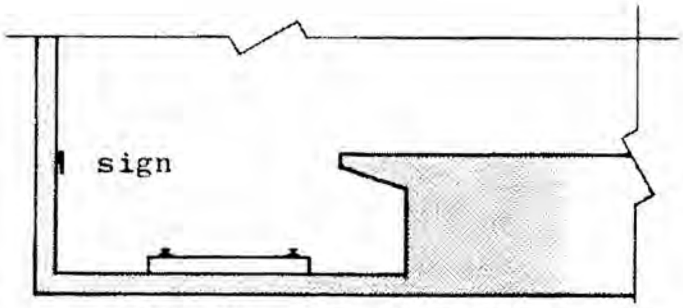
DANGER THIRD RAIL

SIGN - 1/8 FULL SIZE

Lettering size: 3"

Color: Yellow letters on black background

Artwork: Standard Authority Unit



STATION - PLATFORM AND TRACKS

Application: Silk screen directly to wall, or use decal of pressure sensitive polyvinyl-flouride film.

Material: Acrylic silk-screen ink.

Use: Along length of platform, once every structural bay, or every 20'.

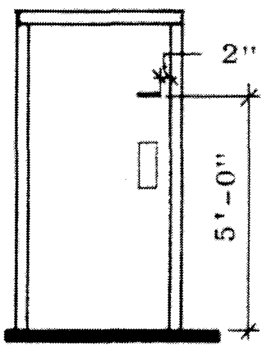
WARNING SIGNS - "DANGER THIRD RAIL"

MEN

WOMEN

SIGNS - 1/2 FULL SIZE

Lettering Size:	1"
Color:	Black
Artwork:	Standard Authority Unit



ELEVATION - TOILET ROOM DOOR - (OUTSIDE)

Position:	Over push-plate, as shown, flush right to push plate outer edge, on doors with opposite swing relate signs flush left to push-plate edge.
Application:	Silk-screened directly onto painted steel door face.
Material:	Acrylic silk-screen ink.
Use:	Sign denotes all public toilet rooms when on platforms and all Authority toilet rooms when within Authority-only circulation.

ADVISORY SIGNS - TOILET ROOMS

This clock face has been designed using Authority standard numerals and letter spacing for maximum legibility and clarity. It is for use on all clocks within the jurisdiction of the Authority. See Part IV for details and manufacture.

ADVISORY SIGNS - CLOCK FACE

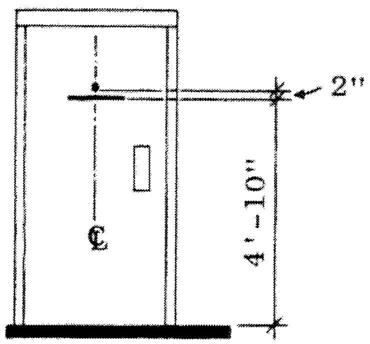
Ⓣ PERSONNEL ONLY

SIGN - $\frac{1}{4}$ FULL SIZE

Lettering size: 1"

Color: Black or gray doors.

Artwork: Standard Authority lettering and symbol, and standard letter spacing, see sheet C2.0.



ELEVATION - DOOR

Application: Silk screen applied directly to surface of door.

Use: Identification of all Authority (non-public) doors and rooms within RTL stations.

AUTHORITY FACILITIES - T PERSONNEL ONLY

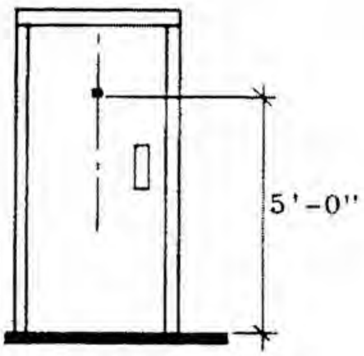
1 2 3 4 5
6 7 8 9 0

SIGN: ½ FULL SIZE

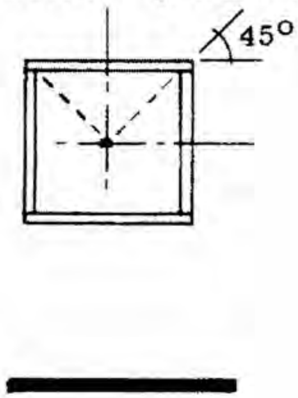
Lettering size: 2"

Color: Black on gray doors, white on black doors.

Artwork: Standard Authority numerals and spacing. See C2.0.



ELEVATION - DOOR



ELEVATION - CABINET

Application: Pressure-sensitive letters applied directly to door.

Material: Pre-cut polyvinyl-flouride film.

Use: Identification of all Authority (non-public) doors and rooms within RTL stations.

AUTHORITY FACILITIES - DOOR NUMBERING

This section of the manual provides guidelines for the control and positive use of revenue advertising in stations.

In the past, advertising within stations was not coordinated with other elements, and as a result it became the most conspicuous negative factor in the station environment.

It is by no means the Authority's intention to eliminate advertising. On the contrary, many of the existing stations will have more advertising after modernization than they had before, and all new stations are to include it. Advertising becomes a positive element when its graphic impact is recognized as a major element in the overall station design. This happens when it is located not at random and in conflict with transit information; but in a clearly defined zone. Advertising then becomes an orderly changing exhibition, providing visual animation and pleasure to the Authority's passengers, as well as revenue to the Authority itself.

As has been noted in Section F, advertising panels are the final graphic element in the passenger's entering sequence, occurring at that one point where he may have time to enjoy them. Station advertising should normally be located across tracks opposite waiting passengers, who always stand or sit facing the track. When possible, advertising should be grouped opposite benches. With this arrangement, the advertising panels can be seen but not touched by the public, preventing vandalism. Advertising panels are normally not combined with directional signing.

In special cases, advertising may be placed in station lobbies or passageways if it does not interfere with information graphics, architecture elements, and can be protected from vandalism. At side platform stations where an inter-track structure for support of advertising panels is not possible, advertising may be combined with information graphics on common structures.

The advertising panels to be used consist of two sizes: 2 Sheet with a copy area of 3'-8" x 4'-10" and 6 Sheet with a copy area of 5'-0" x 12'-0". These panels can be used interchangeably in conjunction with a standard support system which incorporates hanging clips 3'-0" O.C. horizontal spacing and 3'-9½" O.C. vertical spacing. The supporting system which may be free standing, wall or column mounted, should provide a strong visual framework for the advertising panels, accommodating the two size panels at random. The smallest frame will support two, 2-Sheet panels or one, 6-Sheet panel. Frames may be longer, but must be in even multiples of 2-Sheet panels. In busy stations, the frame may form a continuous structure running all or most of the platform length. When located between tracks at a side platform station, gaps should be left to permit visibility of one platform from the other.

GENERAL DESCRIPTION AND GUIDELINES

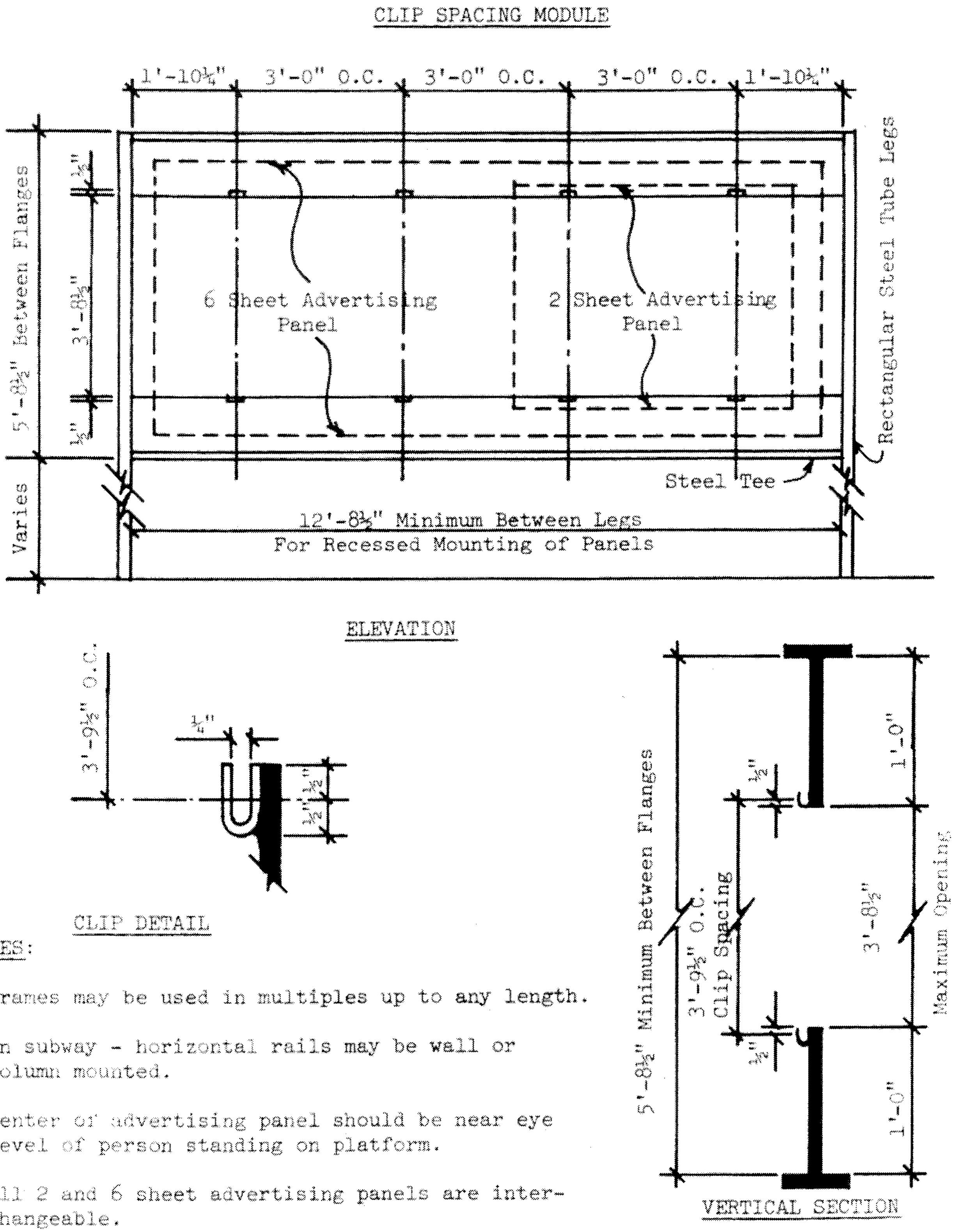
For maximum visual impact, panels should be grouped in clusters rather than scattered along walls or spaced widely apart from each other. In subway or fully enclosed stations, advertising panels should have accent lighting. Remote spot or flood lighting is used but care must be taken that lighting does not annoy passengers waiting on the other side of the panels.

For additional general guidelines, see Part I, Guidelines and Principles.

For sample layouts of posters at individual stations, see Part III, Station Modernization Program.

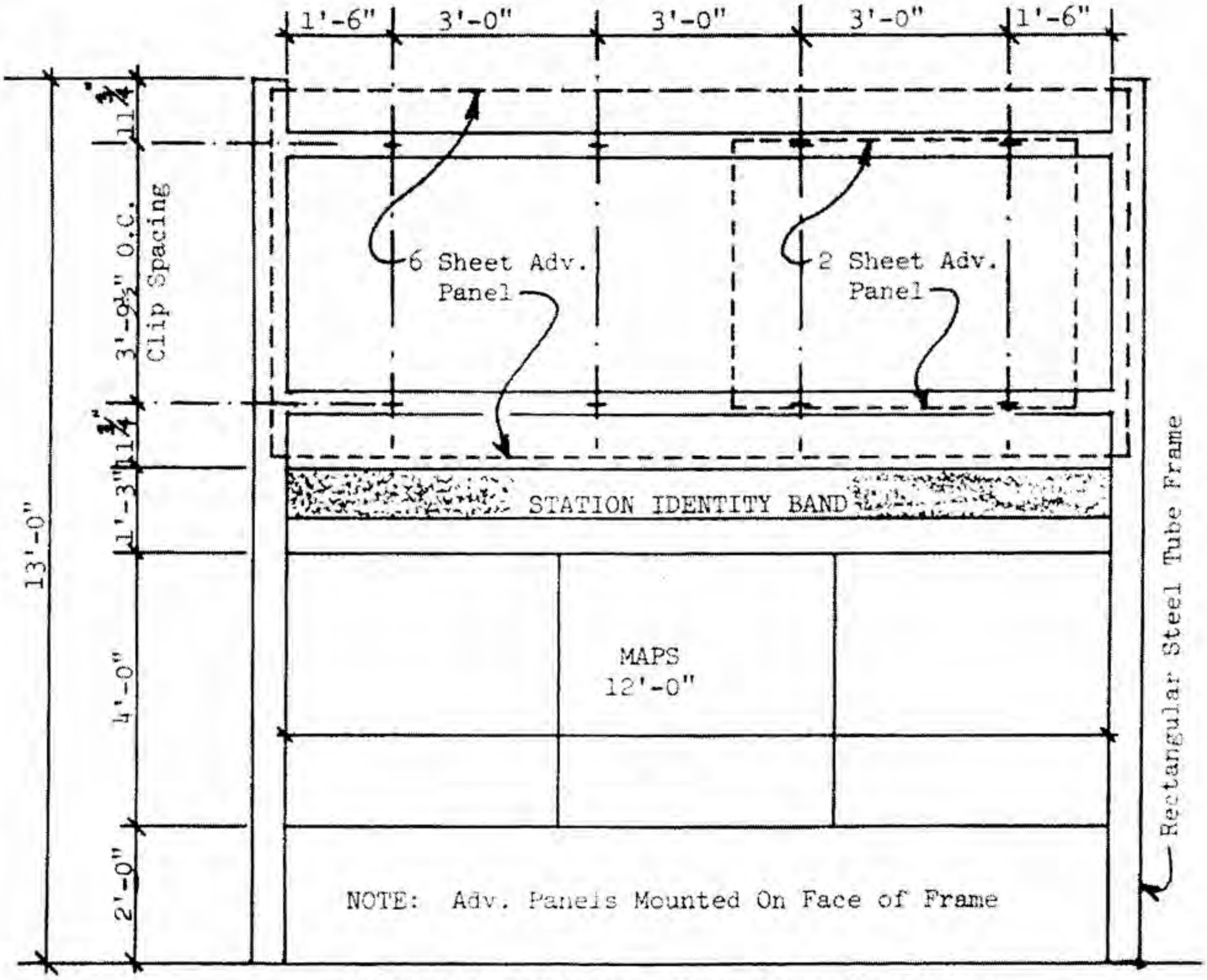
For details of frames and panels, see Pages L5.0 to L5.3 in this section.

GENERAL DESCRIPTION AND GUIDELINES (cont'd.)

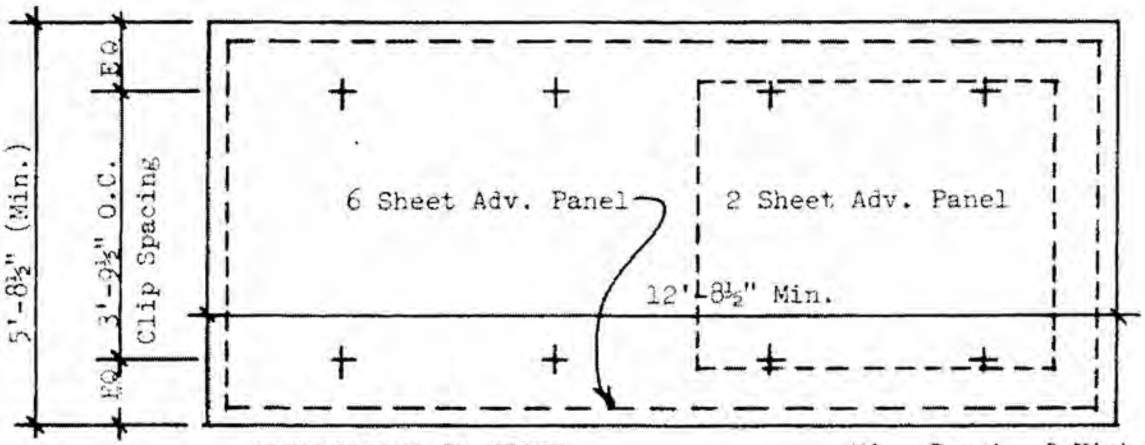


NOTES:

- Frames may be used in multiples up to any length.
- In subway - horizontal rails may be wall or column mounted.
- Center of advertising panel should be near eye level of person standing on platform.
- All 2 and 6 sheet advertising panels are interchangeable.
- Frame to be painted black - Semi Gloss.

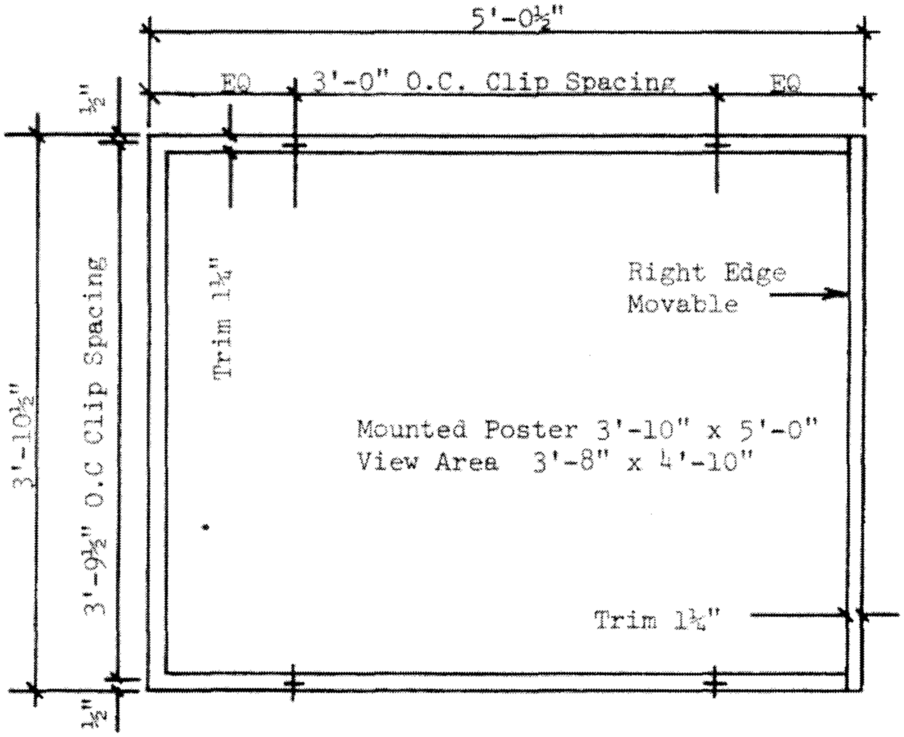


ADVERTISING COMBINED WITH PLATFORM GRAPHICS

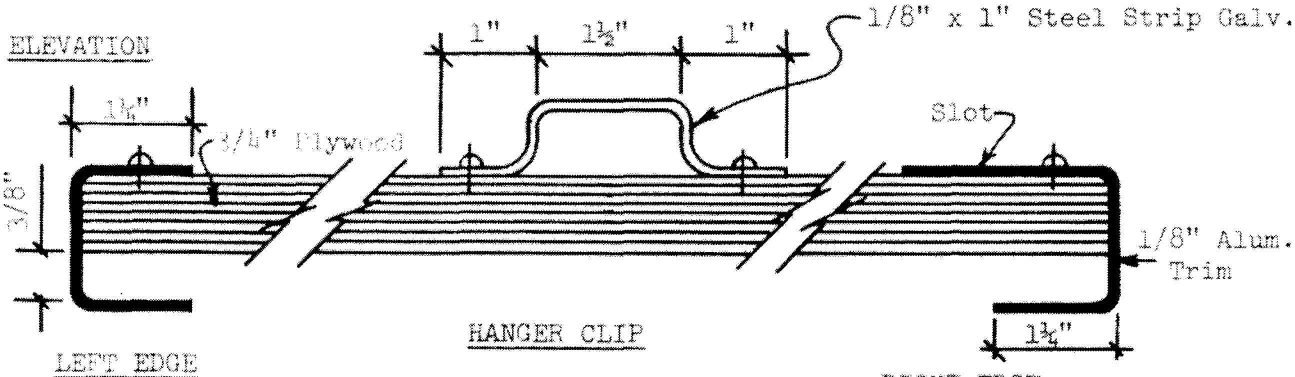


ADVERTISING IN NICHE

Min. Depth of Niche = 4"



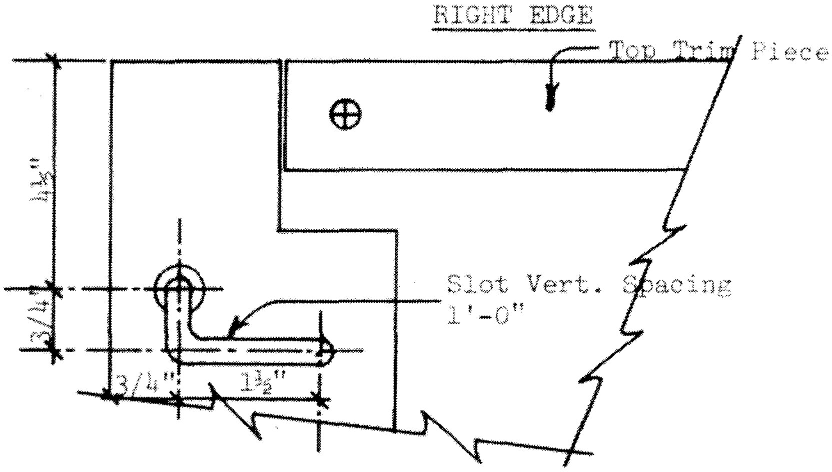
ELEVATION



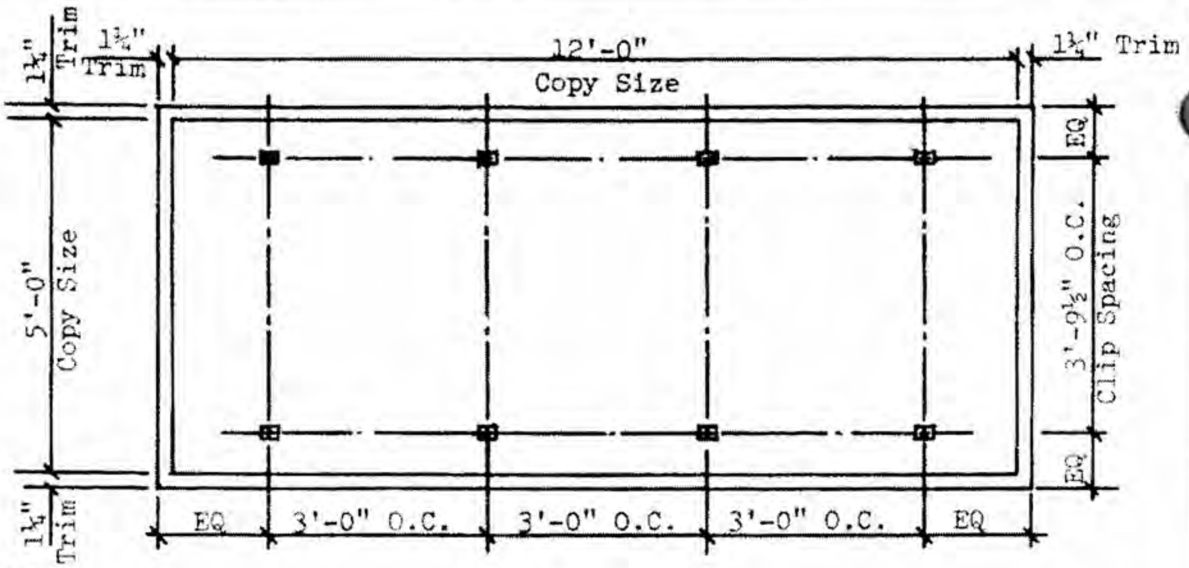
DETAILS

NOTES:

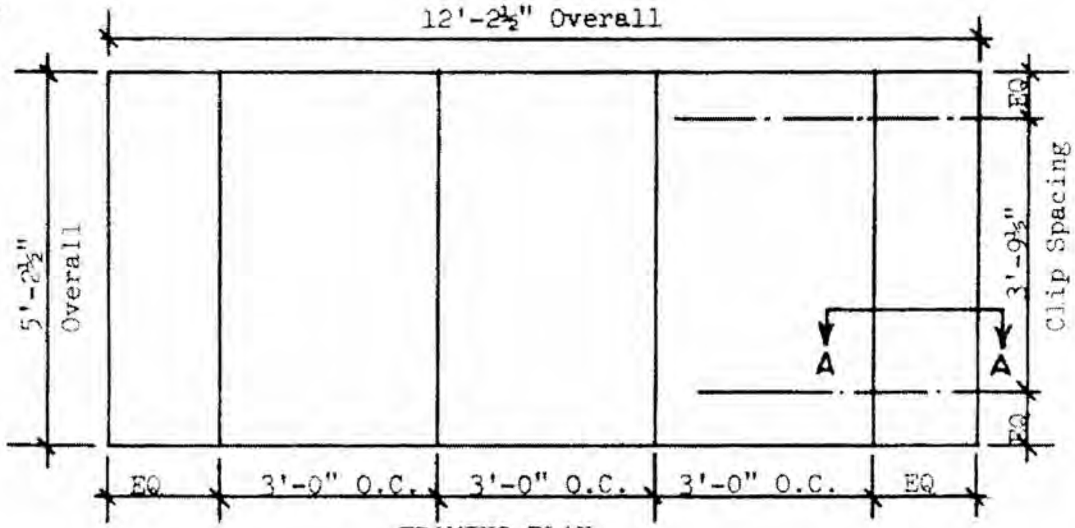
- Aluminum Frame to be anodized black
- Plywood to be finished both sides (exterior grade)
- All fasteners to be rust-proof



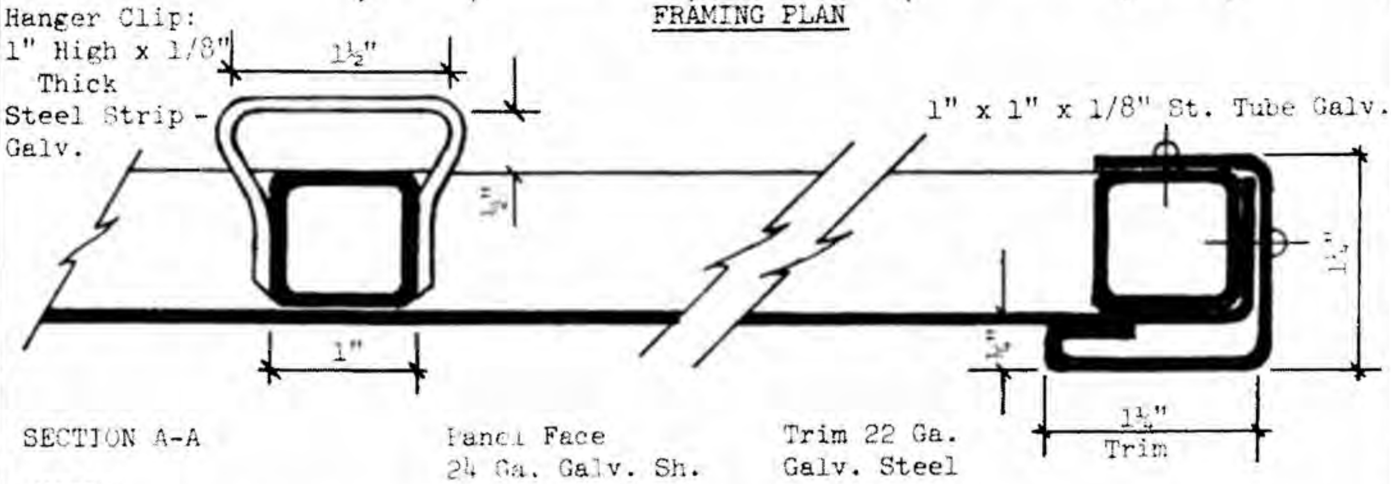
BACK VIEW OF MOVABLE EDGE



FRONT ELEVATION



FRAMING PLAN



SECTION A-A

NOTES:

Painting - Trim and back of panel - Black - Semi Gloss
Fasteners - No screws or rivets allowed on front face of panel or trim
Wind Load - 20 Lbs./Sq. Feet
Advertising Copy Size - Six Sheet - 5'-0" x 12'-0"

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY MANUAL OF GUIDELINES AND STANDARDS	GRAPHICS	V
	REVENUE ADVERTISING	L5.3

MANUAL OF GUIDELINES AND STANDARDS

Part VI of the Manual describes the basic design goals for station lighting. It diagrams typical station lighting situations, and fixture types to accommodate them.

Each Station Architect is responsible for a lighting layout designed in conformance with the Basic Goals, and utilizing, insofar as practicable and unless directed otherwise, the standardized fixture types.

PART VI LIGHTING

A. STATION LIGHTING

B. FIXTURE TYPES AND TYPICAL USE

Adequate lighting denotes well being. It is perhaps the single most important element in the revitalization of the subway. Low lighting levels, without appreciable variation or contrast, and mazes of unorganized conduit and unrelated fixtures are characteristic of many existing stations. The following basic goals have been adopted for the lighting design of new and modernized stations.

1. General Illumination

   Minimum lighting level in public areas should be twenty (20) footcandles, maintained at floor level.

   General illumination should not be designed on the basis of a uniform level throughout the station, but rather with variations in level as may be required by the particular station layout.

2. High Lighting of Danger/Decision Areas

   High levels of directed light should occur at potential danger areas (stairs, escalators, platform edges, hidden corners), and at decision areas (fare collection equipment, information graphics).

3. Spatial Definition

   Many stations have a basic clarity of form that can be emphasized by properly designed lighting.

4. Exterior/Interior Transition

   Abrupt differences in lighting levels between exterior and interior should be eliminated.

5. Orientation

   In general, maximum contact with surface features should be carried into the station, in order to maintain orientation to the above ground world. In many cases, it will be possible to open up portions of the overhead to bring natural light into stairways, mezzanines, or even platform levels. Where skylight shafts are used, night time illumination should be provided to substitute for daylight.

INTERIOR LIGHTING STANDARDS

Differences in lighting levels can be used to improve orientation within the station proper. Intense levels will draw the patron and forewarn him of decisions to be made.

6. Special Emphasis

Certain orientation features, such as color coded walls, or graphic elements, such as murals or advertising, should in most cases be given special accent lighting.

7. Elimination of Clutter

Lighting installations should be designed with layout appearance as well as simple coverage in mind, and conduit should be concealed. In existing stations where this is impossible, fixtures should be designed to incorporate raceways wherever practicable. Exposed conduit runs should be held to a minimum, and definitely located by the Station Architect.

8. Emergency Lighting

Emergency lighting will be required in all stations, located to provide a general level of illumination of 4 footcandles, with concentrations at danger areas.

Existing subway stations should utilize existing D.C. sources, incandescent lamps five in series on 600 volts D.C. and normally energized.

New stations should be provided with a natural gas driven engine/generator for emergency power. Emergency lights shall be fed from panels normally fed from normal power source with transfer to generator on normal power failure.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MANUAL OF GUIDELINES AND STANDARDS
REVISED 1974

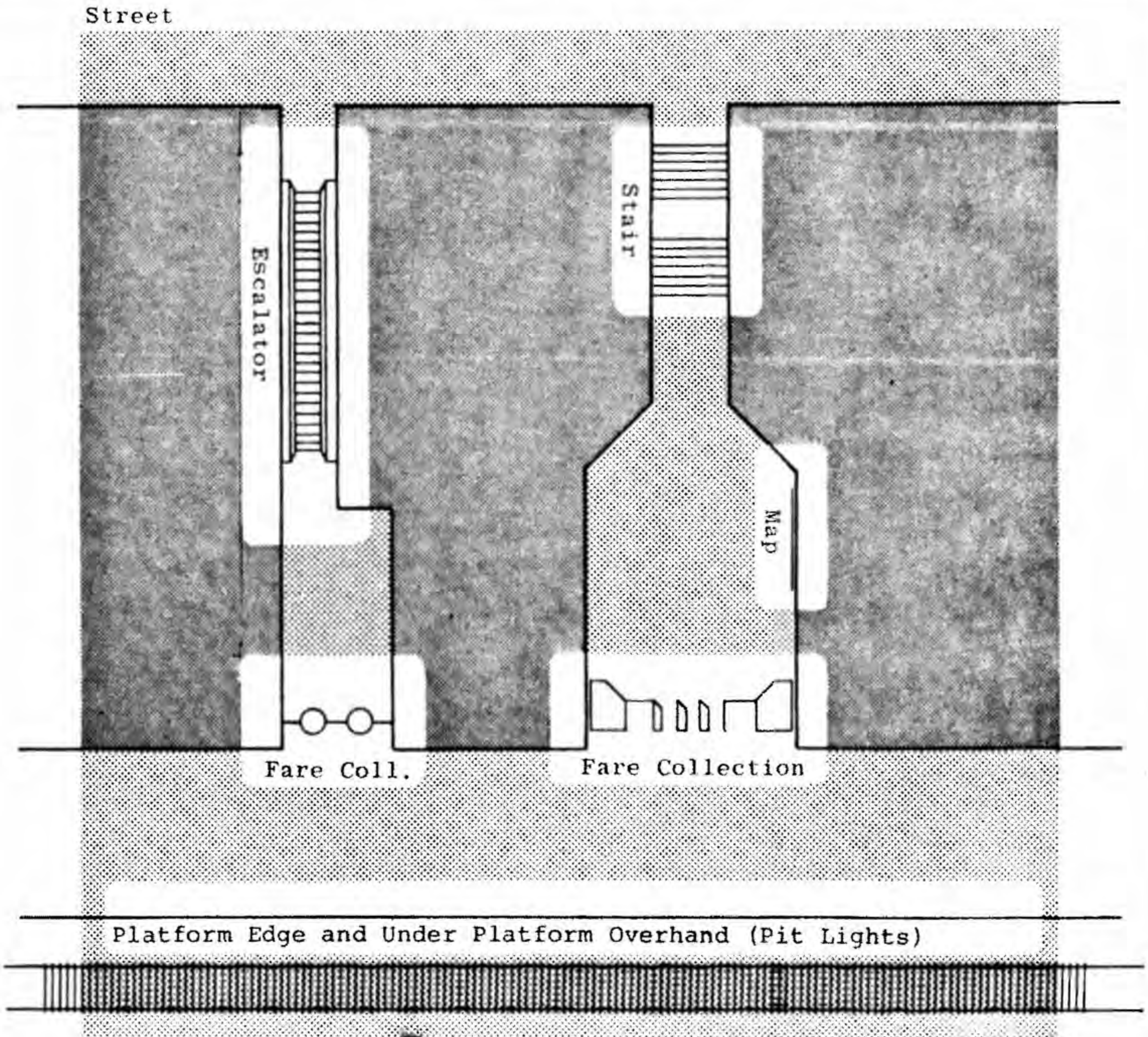
STATION LIGHTING

LIGHTING

VI

A1.2

INTERIOR LIGHTING CONCEPT



The type of lighting and the light intensity will be determined by the function of the area.

Lighting for the pedestrian should be in scale to the human figure. Rows of lights may be used to indicate direction or define paths. Lighting in parking areas should be of a quality and intensity, preferably high pressure sodium, to impart a sense of safety. Self-parking areas and paths require one footcandle of illumination. Large parking areas should be 2-3 foot candles.

Direction and information signs may be brightly backlit for contrast. Surface illuminated sign boards need fifty foot-candles on dark surfaces. Backlit signs should be used whenever possible as they are more easily seen at night than surface illuminated signs. Care in placement, color selection, and intensity of light will be necessary to avoid washing out colors and graphics.

Light fixtures should be as vandal resistant as possible, with polycarbonate or high impact acrylic diffusers, particularly those which might be within reach of pedestrians.

Poles should be heavy gauge, extremely rigid, with hand hole and fixed base.

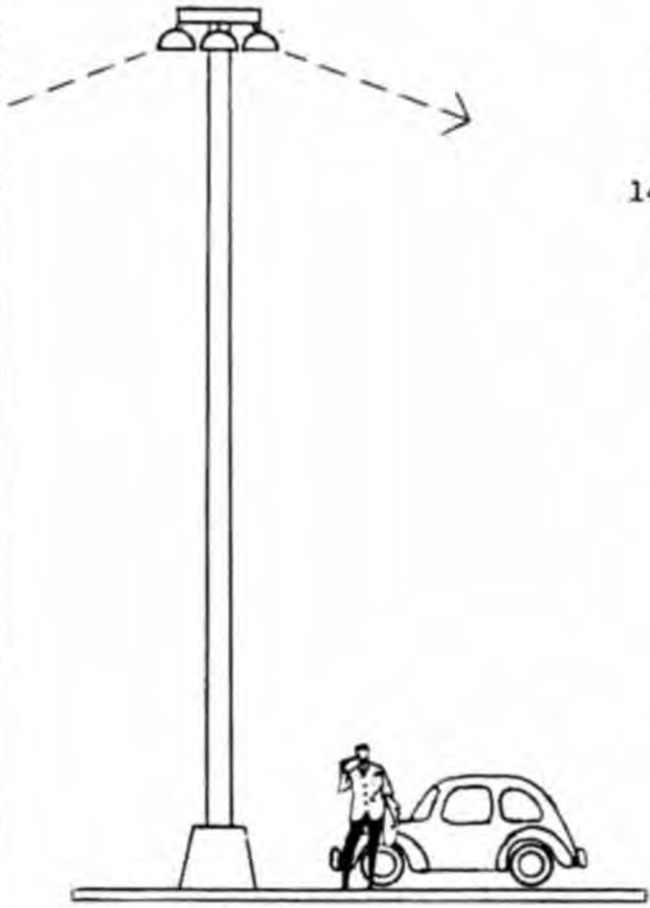
All wiring for exterior lighting fixtures should be buried in plastic coated rigid steel conduit. Overhead wiring will not be permitted.

For large areas, parking, train and bus storage, etc., serious consideration should be given to high mast lighting to minimize number of poles and luminaires. High mast installations should be of type that permits lowering of the luminaire assembly to ground level for servicing.

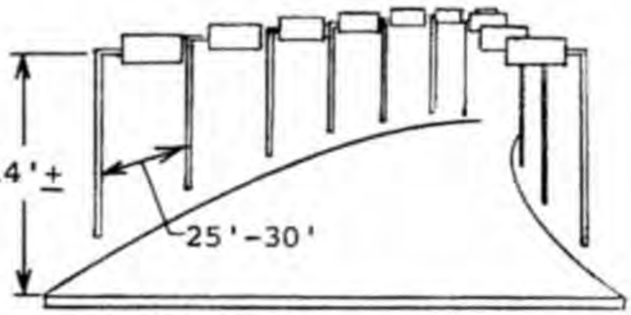
Maximum mounting height of fixed luminaires shall be forty (40) feet to permit servicing by bucket truck, where truck access is available.

Ease of maintenance of <u>all</u> fixtures is of prime concern.

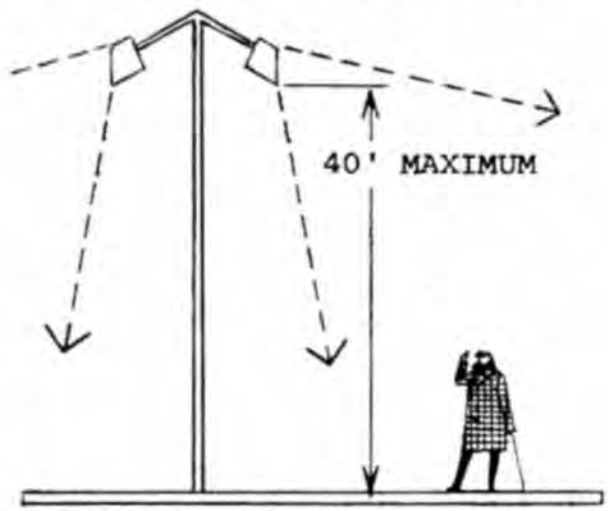
EXTERIOR LIGHTING STANDARDS



HIGH MAST LIGHTING
(LARGE AREAS)



LIGHT TO INDICATE DIRECTION



HIGH INTENSITY HIGH LEVEL

EXTERIOR LIGHTING CONCEPT

1. Present distribution system

All station lighting at present is supplied from the Authority's 600 volt direct current lines, run on the tunnel walls. There is one power cable and one light cable in each direction, i.e.: North Bound Power, North Bound Light, South Bound Power, South Bound Light. In event of a power cable failure, the load can be transferred manually. In event of a complete D.C. failure, the light cables are transferred to 550 volt AC at substations to provide emergency lighting. All lighting is incandescent, generally 101 watt, 151 watt and 201 watt street railway lamps, wired five in series. Lamps on any one circuit are distributed about the station and circuits are apportioned between power and light cable panelboards so that either circuit failures or cable failures will not darken any one area. This distribution feature constitutes the present emergency system.

2. New distribution system

After a review of present power and re-lamping costs, the Authority has determined that new and modernized stations shall have new service entrances, from the public utility, or T traction substation, and that all normal lighting will be on alternating current. In some cases groups of stations will be served by one entrance, and transformers installed to step voltage up and down for distribution within the tunnel between stations.

At new surface stations provide emergency power by natural gase engine-generator sets or other methods; however the difficulty in venting engines and the time lag in shifting over to such an emergency system prohibits its use in underground stations. For the time being, an emergency system separate from the AC normal system will have to be provided, consisting of five-lamp 600 volt DC series circuits as at present. Separate conduit must be provided for AC and DC wiring. Emergency lighting will normally be energized to provide visual indication that D.C. system is operational.

<u>DISTRIBUTION SYSTEM</u>

1. Pit Lighting

In existing rapid transit stations, there are lights mounted beneath the platform overhang. Lights are incandescent, mounted about 15' on center, wired five-in-series on DC, and are normally ON. This lighting is used by work crews and in emergencies and should be renewed as part of the Station Modernization.

New rapid transit station pits should be illuminated by four foot H/O, gasketed fluorescent fixtures,single lamp, mounted under platform overhang on twenty foot centers. Pit lights should be fed from emergency panel boards and should be normally ON.

2. Lighting of Service Areas

Lighting for other than public areas, public toilets, and built-in collection booths shall be selected for economy and suitability for the area to be lighted. Most service areas will require both normal and emergency lighting.

PIT & SERVICE AREA LIGHTING

The Fixture Use Diagrams illustrate lighting situations frequently encountered in new and existing stations, and show schematic sections of the fixture types which have been selected to meet such situations.

The basic fixture types shown on the Fixture Use Diagrams are commercially available fixtures, modified as may be necessary to meet the criteria for fixtures. Finish is typically baked enamel, matte black color.

FIXTURE TYPES AND TYPICAL USE

INTERIOR LIGHTING

1. In general, lighting fixtures in new and existing stations should be located to minimize their number and bulk. General lighting should be fluorescent. Accent lighting should be High Intensity Discharge (H.I.D.).

2. Accent lighting should occur only at graphics, danger and decision areas, and other special emphasis elements.

3. In both new and existing stations, certain lighting can be controlled by time switches for use only during peak hours or can be controlled by photo-electric devices when daylight falls below minimum levels.

4. It is expected that certain less-busy existing stations will receive little or no new lighting treatment. In these stations the existing normal and emergency DC lighting system will remain, with perhaps new fixtures substituted for old.

5. Fluorescent fixtures in public areas shall use "warm white" lamps.

6. Incandescent fixtures shall be kept to an absolute minimum.

7. In high ceiling areas fixtures must be mounted at height that will permit servicing and relamping without scaffolds or stagings.

EXTERIOR LIGHTING

1. All exterior lighting should utilize H.I.D. lamps, preferably high pressure sodium, wherever possible, for most efficient energy use.

2. Poles for walkway lighting shall be fixed base type with handholes and shall be of heavy gauge and rigidity to withstand extreme vandalism.

3. Fixed poles for large areas, parking, train or bus storage, etc., shall have a maximum luminaire mounting height of forty feet, for servicing by bucket truck, where truck access is available.

   Serious consideration should be given to high mast lighting for large areas to minimize number of poles and luminaires. High mast installations should be of the type that permits lowering of luminaire assembly to ground level for servicing.

<u>LIGHTING FIXTURE STANDARDS</u>

In general, lighting fixtures for use within the Authority's environment should satisfy the following criteria.

1. Fixtures shall function as effective lighting units for a minimum life of 20 years under arduous conditions of weather, vandalism and vibration.

2. Fixtures shall be enclosed and gasketed, wherever possible, to operate effectively in an atmosphere containing sticky abrasive brakeshoe dust, which tends to foul lampholder contacts and makes cleaning of fixtures and their reflective surfaces difficult without scratching, and at a temperature range of -20° to 90°F.

3. The support and installation of fixtures in long continuous runs shall allow for expansion and contraction in an ambient temperature range of -20° to 90°F.

4. In general, through wiring shall be carried in raceways external to the fixture, permitting fixture removal without cutting of wires.

5. Methods of installation should be thoughtfully prepared to accommodate a wide variety of job conditions such as irregularities of wall and ceiling surface, and to minimize errors by untrained personnel.

6. Parts, lamp types, and lengths should be standardized to the greatest extent possible.

7. Non-corroding metal should be used, with adequate protection against galvanic action between dissimilar metals.

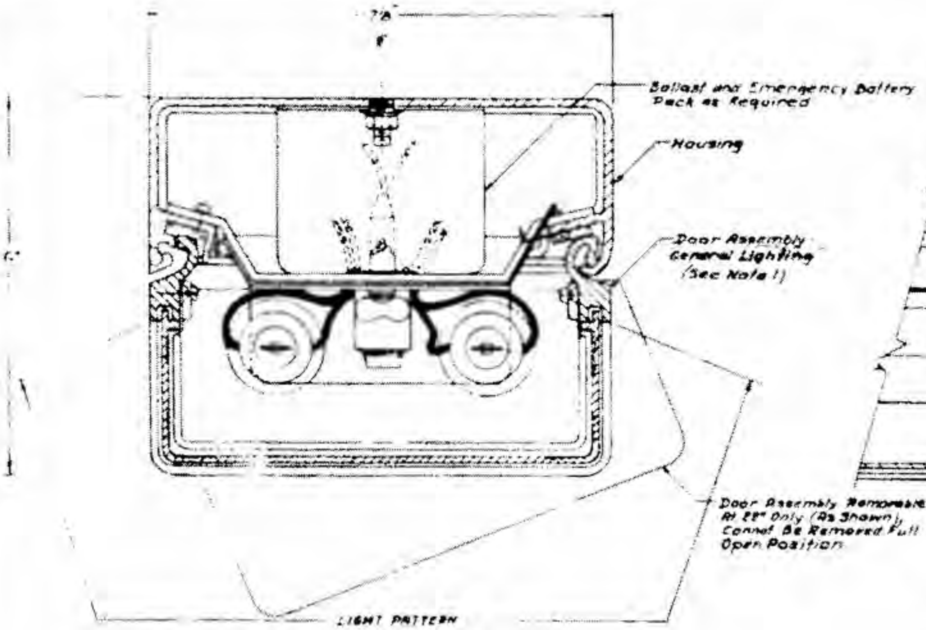
8. Replacement of lamps and ballasts should be easily accomplished.

9. Where open cylindrical fixtures are used, they must be vented at top for heat dissipation.

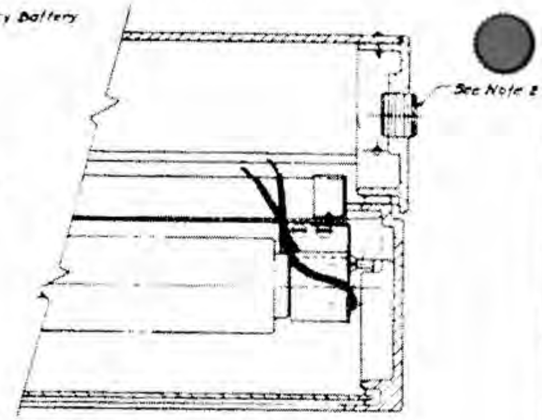
10. Use of incandescent fixtures shall be kept to the absolute minimum.

11. Fluorescent fixtures should be tightly gasketed to prevent dust infiltration.

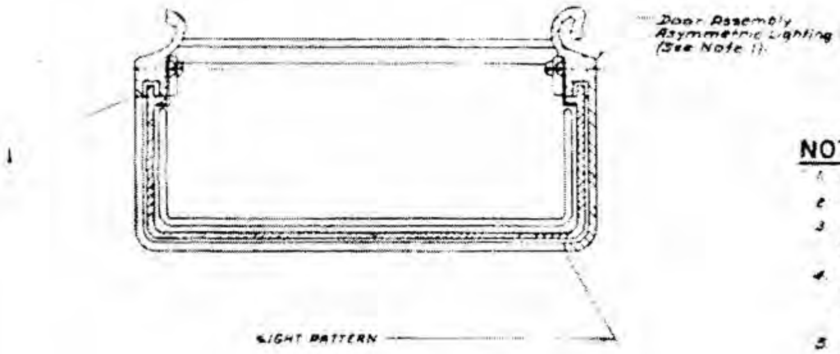
LIGHTING FIXTURE STANDARDS



SECTION A-A

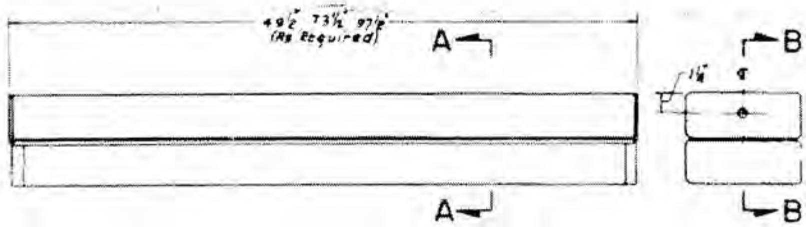


SECTION B-B



NOTES:

1. Door Assemblies Shall Be Interchangeable.
2. ½" Pipe Threads As Required
3. Mounting Holes In Fixture Housing Shall Be Drilled And Tapped As Directed By Installation Contractor.
4. Single Lamp Fixture Shall Be Similar To Fixture Shown, With All Parts Interchangeable, Except Lamp Shall Be Mounted Along Reflector Center And Fuse Shall Be Offset On Reflector.
5. Fixture Dimensions Are Approximate. Exact Dimensions Shall Be Submitted For Engineers Approval.



SIDE VIEW

END VIEW

TYPICAL LIGHTING FIXTURE

(NO SCALE)

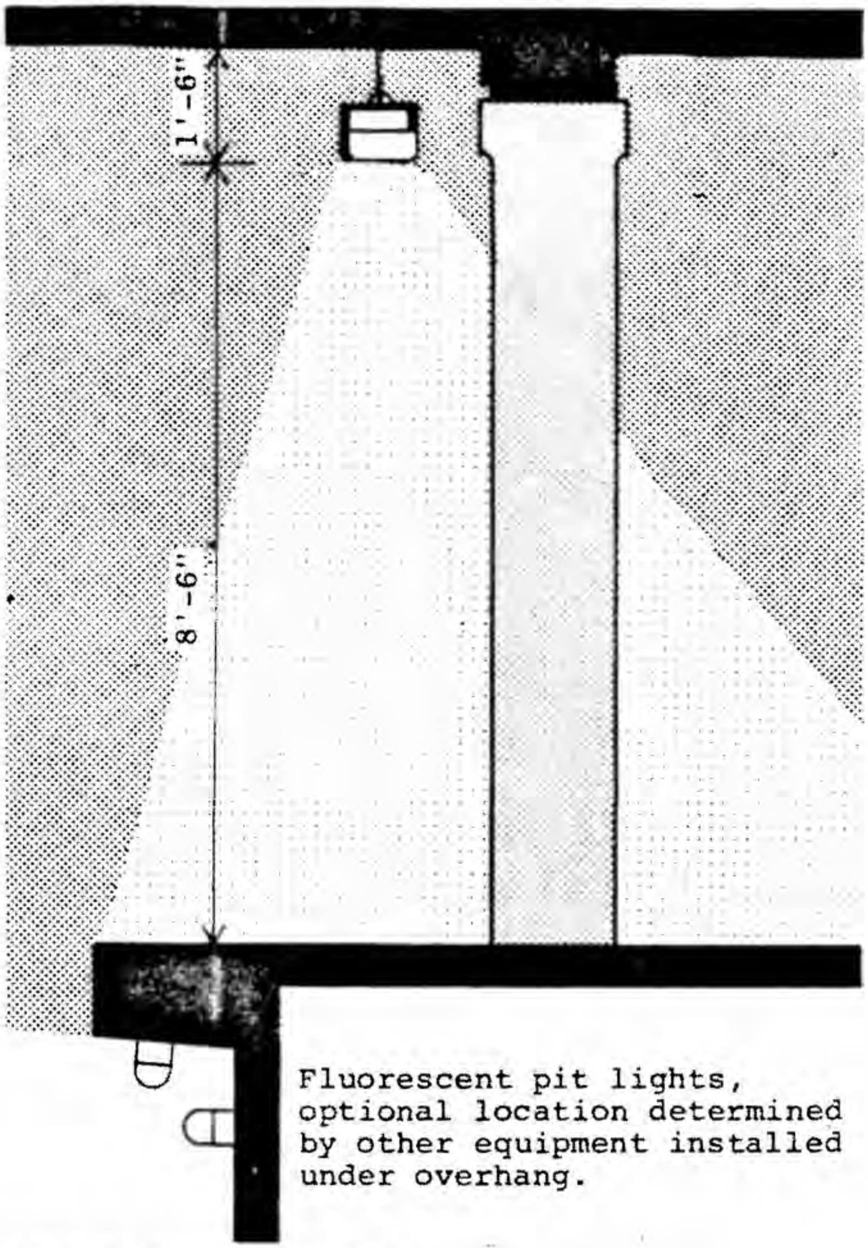
STANDARD FLUORESCENT FIXTURE

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

MANUAL OF GUIDELINES AND STANDARDS

REVISED 1974

LIGHTING	VI
FIXTURE TYPES	B3



Fluorescent pit lights, optional location determined by other equipment installed under overhang.

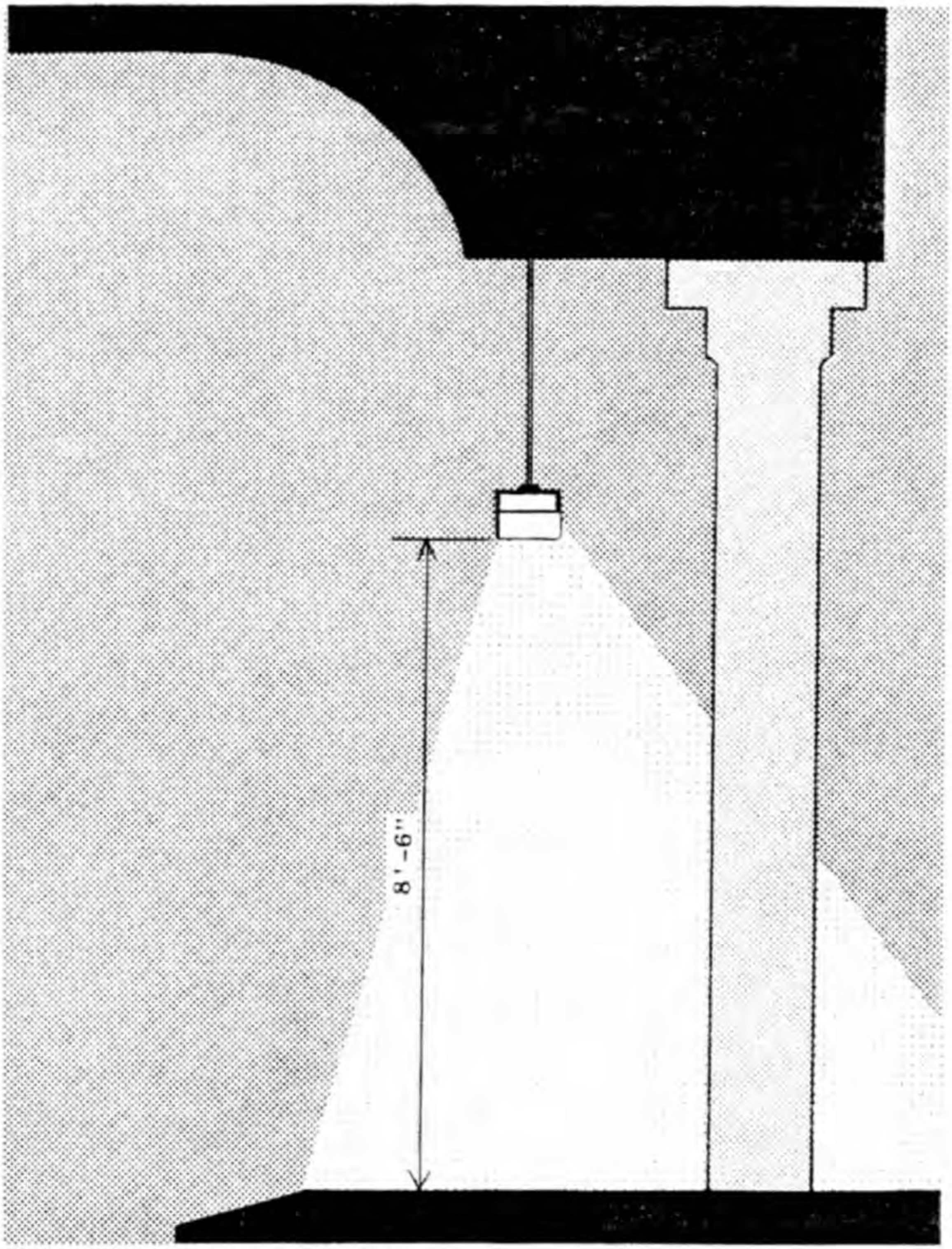
CONTINUOUS FLUORESCENT STRIP

Continuous or intermittent ceiling mounted fluorescent strip, cutoff at platform edge by use of asymmetrical lens. Emergency lights integral with fluorescent strip.

FLUORESCENT PIT LIGHT

4 foot single lamp H/O, enclosed and gasketed fluorescent fixtures mounted 20 ft. on centers

HIGH PLATFORM STATION

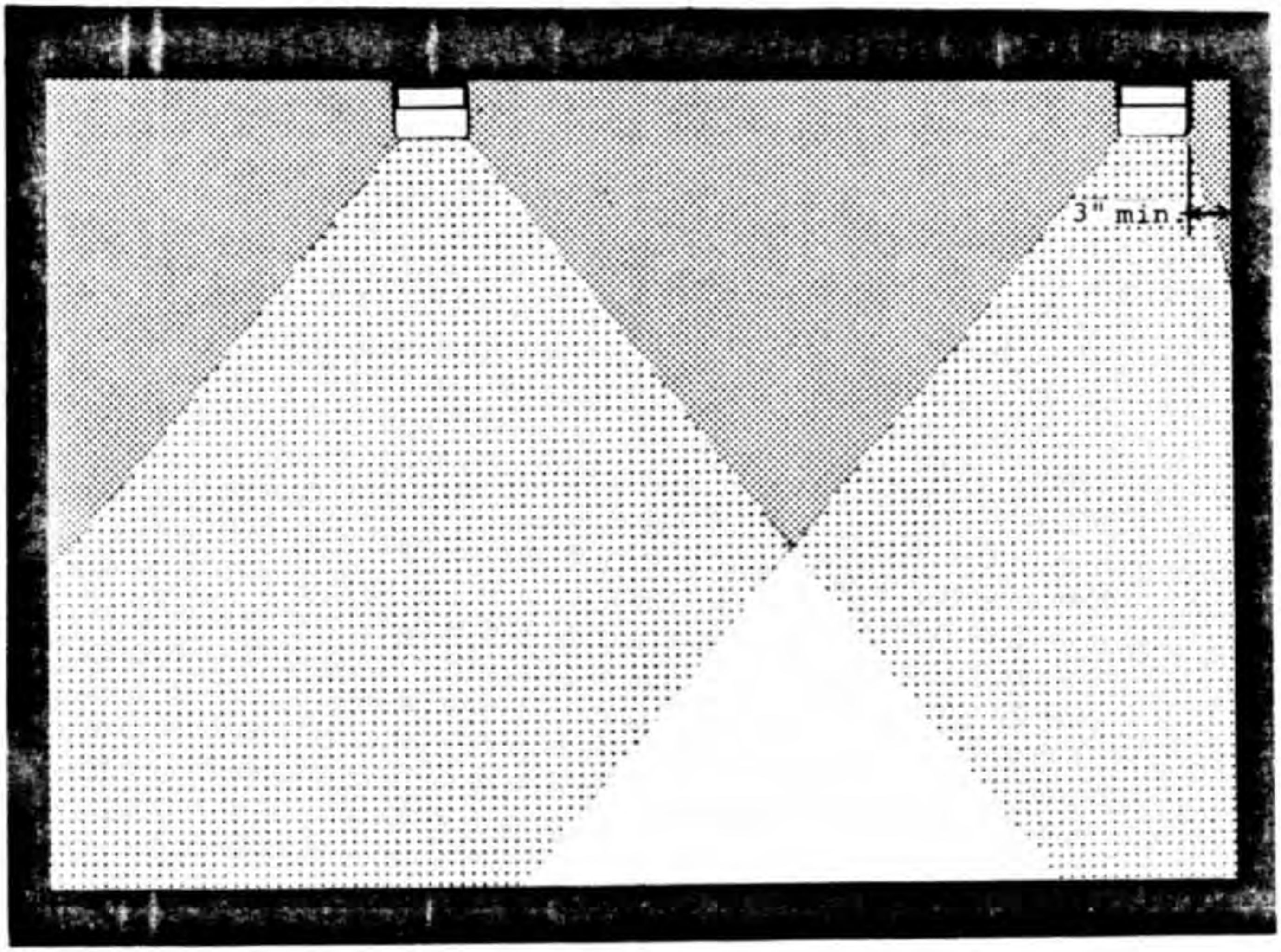


CONTINUOUS FLUORESCENT STRIP

Continuous suspended fluorescent strip, with cutoff at platform edge. Integral emergency lights.

LOW PLATFORM STATION

Symmetrical Asymmetrical

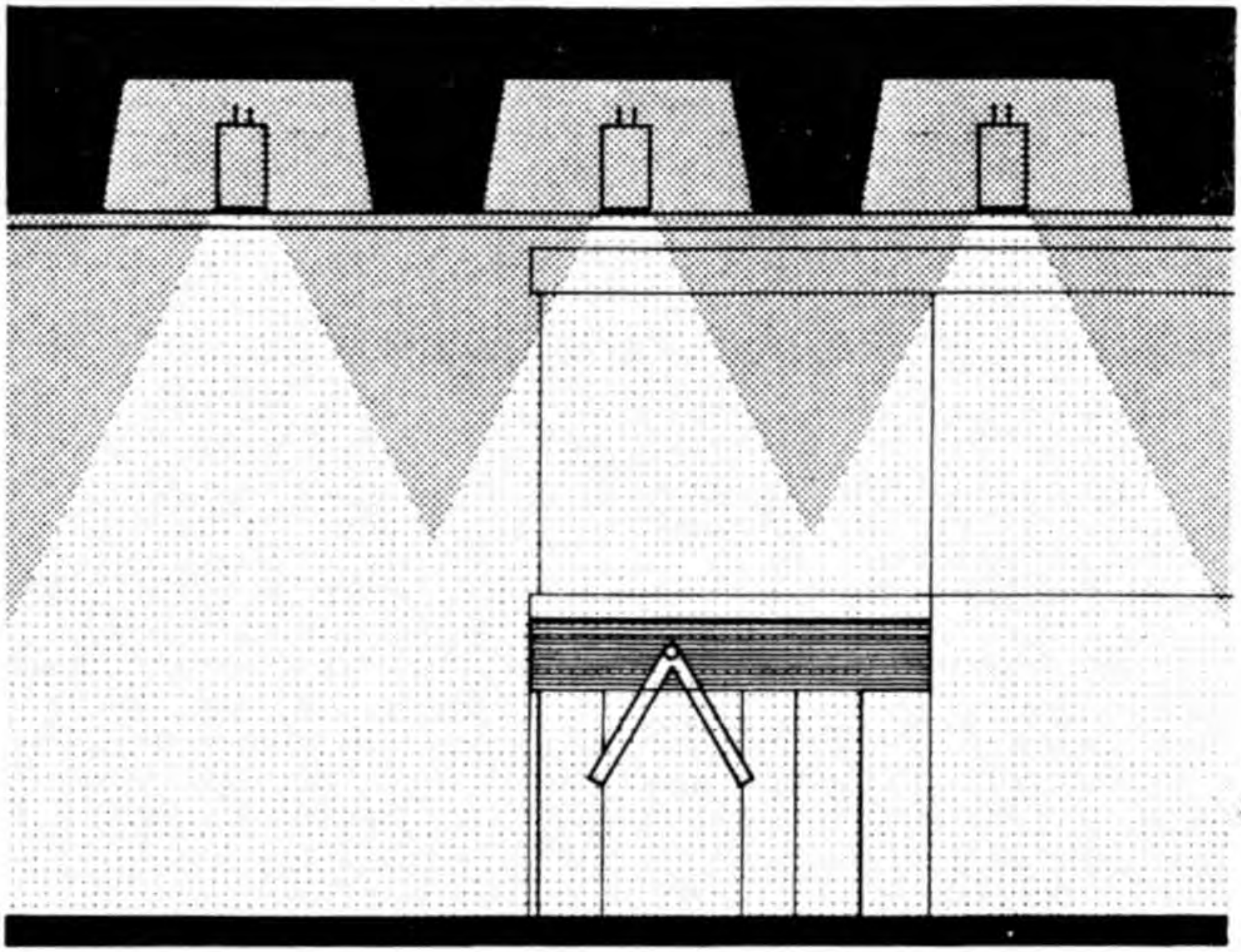


Continuous Fluorescent Fixture

Symmetrical fixture for area lighting.

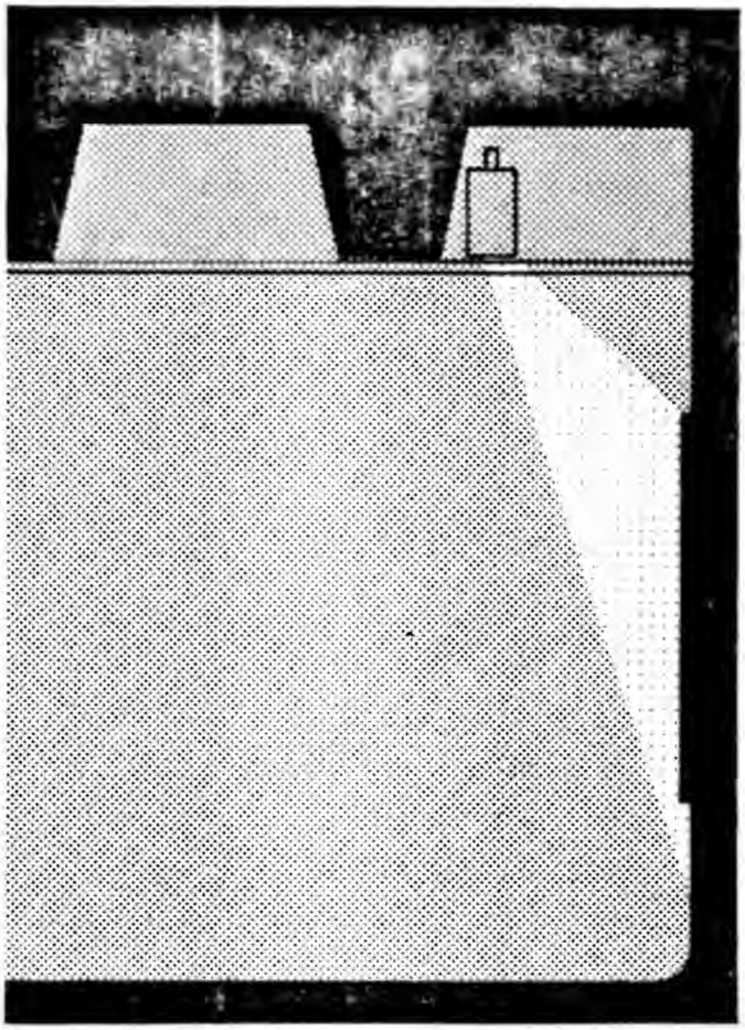
Asymmetrical fixture for wall wash.

PASSAGEWAY



Raceway - supported High Intensity Discharge downlights.

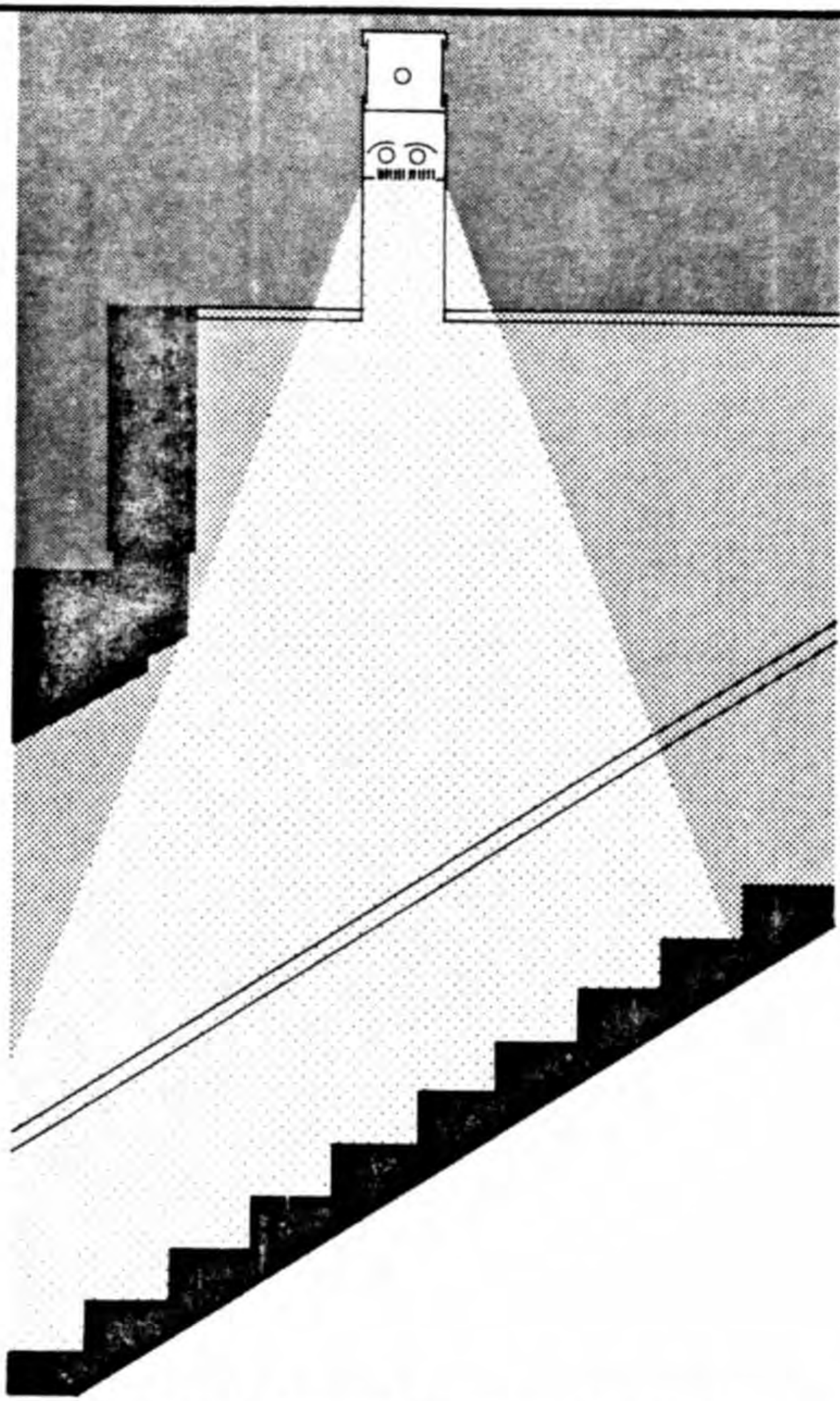
FARE COLLECTION AREA



Raceway - supported High Intensity Discharge wall washer.

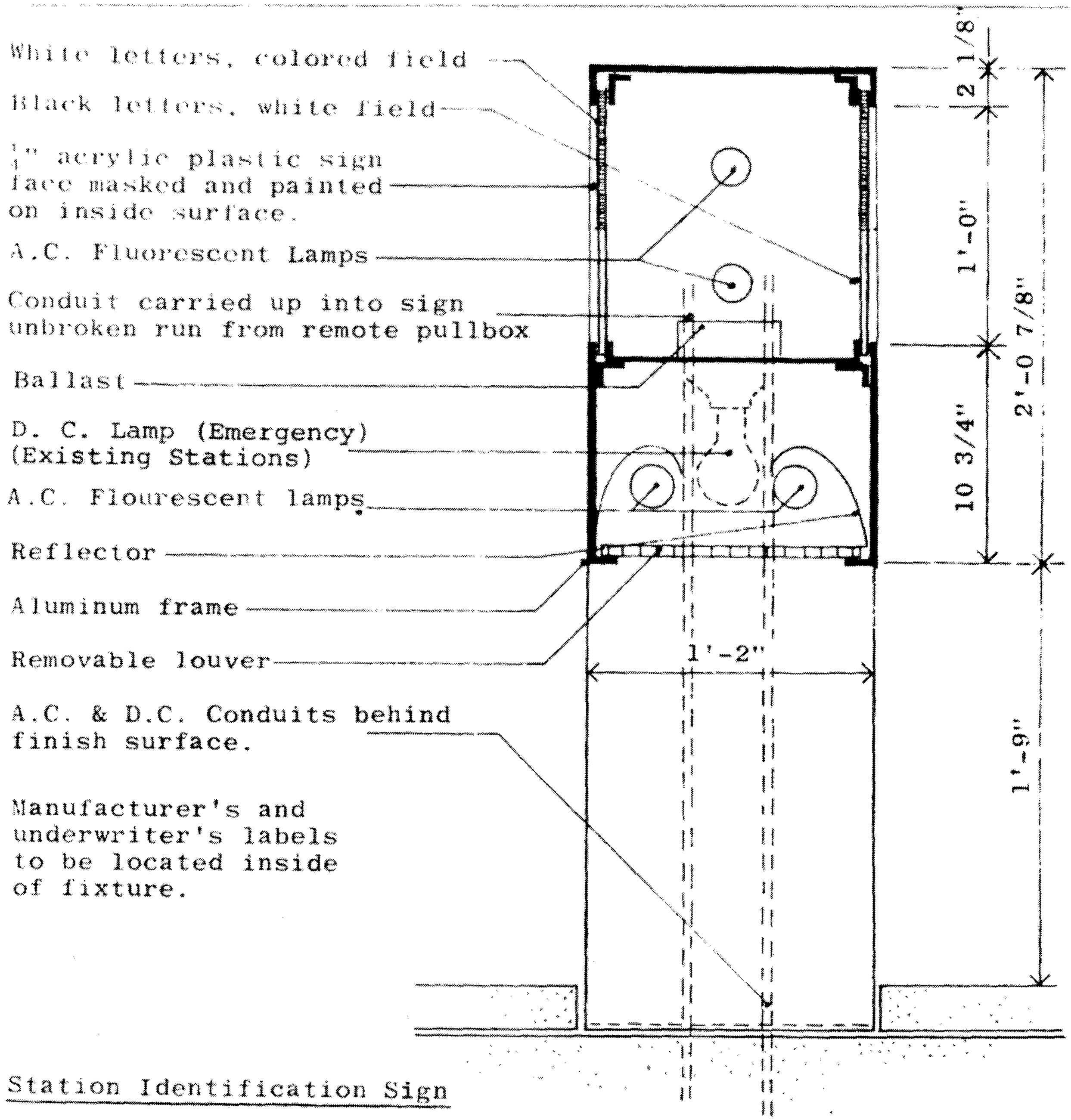
Blanked out reflectors as required.

WALL MOUNTED GRAPHICS



Combined illuminated sign and fluorescent stair fixture.
Integral emergency lights.

EXTERIOR ENTRY STAIR

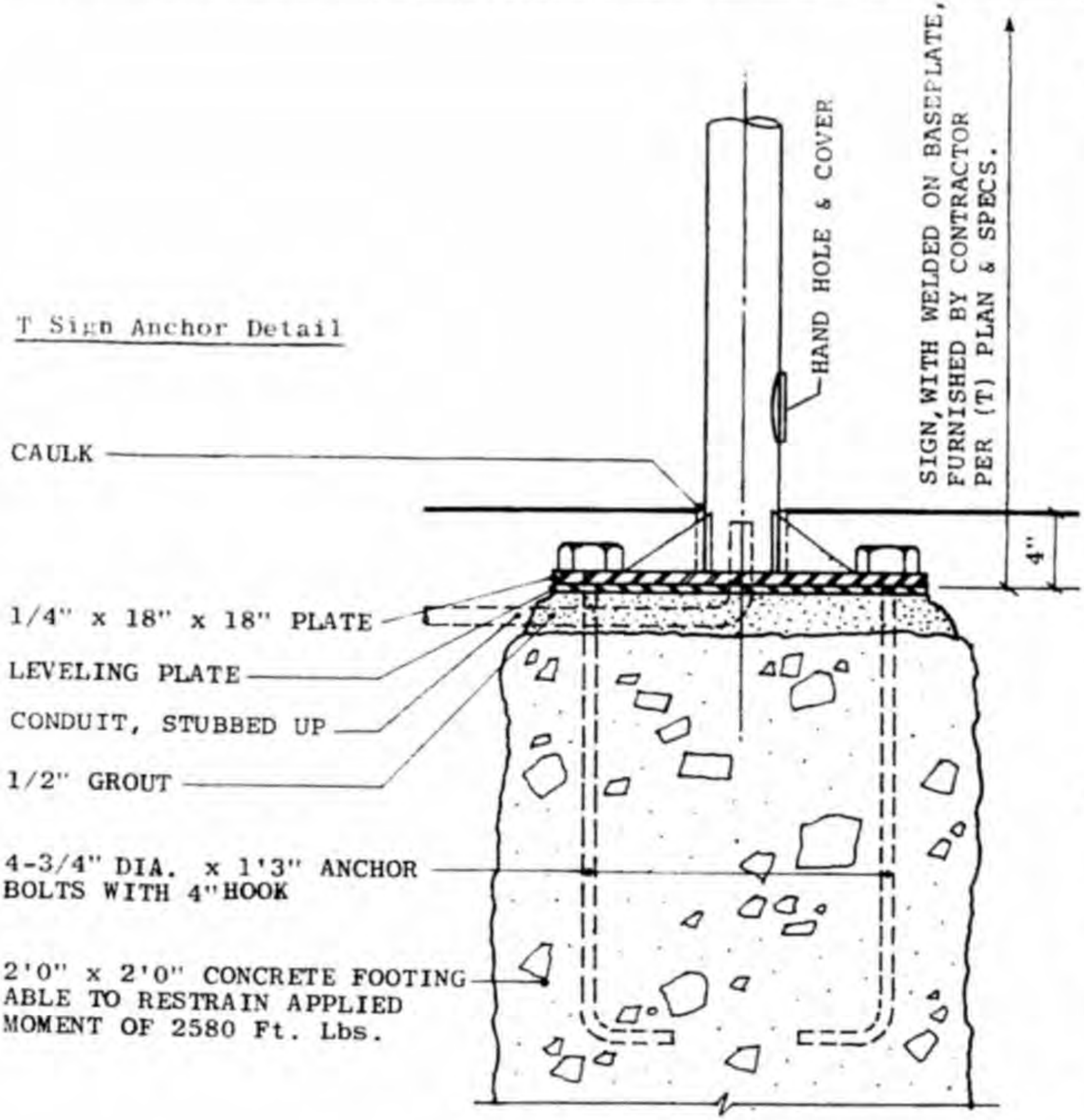


Station Identification Sign

Sign interior is schematic. In dimensions and appearance, this sign lighting fixture is a standard component with no variations permitted.

Fluorescent: 800 ma, full width of sign
Incandescent (emergency, D.C.): 2 - 151 watt, 600 volts, wired 5-in-series. (Existing Stations)

MISC. FIXTURE DETAILS scale $1\frac{1}{2}$" = 1'- 0"



ELECTRICAL SERVICE

2 - #12 WIRES, 1 - #12 GROUND WIRE, OR LARGER, DEPENDING ON LENGTH OF RUN.

60 HERTZ - A.C. VOLTAGE AS REQUIRED.

T SIGN BASE

MISC. FIXTURE DETAILS

MASSACHUSETTS
BAY
TRANSPORTATION
AUTHORITY

GUIDELINES AND STANDARDS
PART VII
MATERIALS
REVISED 1977

GENERAL INTRODUCTION

The Massachusetts Bay Transportation Authority has found it both necessary and possible to concentrate attention on the complex needs of people. Programs to improve service must now include a new emphasis on the quality of the transportation experience. In effect, transportation engineering has been joined by human engineering and environmental design.

This manual provides a framework for the continued coordination of all those elements in the system that affect human comfort.

Many of the criteria involved are common to all environments, such as the control of light, noise, humidity, temperature, wind, and odors, or the need for orderliness, through clear and easy circulation and clean appearance. Other criteria that are more specific to the transportation environment are such needs as safety, traffic handling capability, spatial variety, consistently available information, and orientation.

The most important single criterion that has guided the preparation of this manual is the need for orientation. The rider must not only be physically comfortable, he must also know in the fullest sense where he is and where he is going.

Since to the layman a public transportation system is to a large extent an invisible skeleton of the city and metropolitan region, the comprehension of that structure generates an awareness and appreciation of the city itself, and an appreciation of travel through it.

There are many aspects to achieving this orientation. Circulation at all points must be direct and open. Spaces should relate visually to their surrounding environment, either through direct openings to adjacent spaces and structures, or in the case of platforms, by graphic reflection through photographic murals.

Above all, the need for orientation places great emphasis on maps and a consistent system of identification and directional signing. Graphics then emerges as a major factor in the design of each environment, a factor that must be given high priority in the early design phases of each project.

It is hoped that all participants in all programs will familiarize themselves with the entire manual, so that the implications of each decision can be understood in a system-wide context.

The standards and guidelines presented here are not inflexible rules. They are a framework for meaningful development and variety, and offer no restriction to the capacity of each participant to evolve better solutions to old or new problems.

As new solutions are developed and approved, revised and additional pages for the manual will be issued to all participants.

Part VII of the Manual establishes standards by which materials and finishes proposed for use in the System will be judged. It lists a number of materials and finishes which have been already approved, subject to review by the Director of exact specifications and area of intended installation.

This part provides information on materials and details in use for standardized wall elevations, built-in graphics and other repetitive elements, and includes design standards for the printing of modernized and yet-to-be modernized stations.

For detailed layout requirements of graphic elements, refer to Part V, Graphics. For information regarding acoustic materials, refer to Part VIII, Acoustics. For laterials requirement in specific non-public rooms, refer to Part IX, Service Facilities.

INTRODUCTION

PART VII MATERIALS

See also Part, Graphics, Section 0:
Fabrication and Installation

It is the intent of the Authority to utilize materials and finishes throughout the System that will satisfy necessary standards of safety, durability, maintainability, and economy, while at the same time contribute substantially to a station environment that is, in fact and in appearance, clean, dry, odorless, well-lit, physically safe, as quiet and as comfortable as is reasonable consistent with station function, and above all, that affords a basic clarity of station form and user orientation.

The following criteria pertain to materials and finishes used in public areas only, including public lavatories, built-in collection booths, and service rooms into which the public can normally see. Materials and finishes for service areas not normally exposed to public view shall be judged solely on the basis of economy, and suitability for the use intended. See Part IX for functional requirements of lavatories and other service facilities.

Criteria

1) Safety

In general all materials and finishes used in the system shall be incombustible, although certain minor elements may be of wood, rubber, or plastic. Plastic or rubber materials used over any significant area shall be of a composition that does not support its own combustion, when in place.

All materials and their attachments shall be designed to adequately withstand normal operational vibration, the effects of aging, and especially the extreme demands placed on Authority property by theft and vandalism.

Materials and finishes shall be selected that provide adequate slip-resistance, glare-resistance, and other qualities that recognize the frequent presence of crowds, and of the handicapped and infirm.

2) Durability

Materials and finishes shall be used that provide long useful life, without decay, corrosion, weakening, decline in appearance, or other failure under normal conditions of use.

CRITERIA FOR MATERIALS

3) Maintainability

Specification of materials and finishes shall recognize that frequent high quality maintenance cannot be depended upon; and therefore materials with impervious surfaces that resist soiling, and, having been soiled, that tend to hide the soil, will go far to counteract deficiencies in maintenance. By the same token, materials and details that complicate cleaning operation, or which provide unnecessary surfaces to collect dirt, must be avoided. Joints between units shall be minimized, and made of the most durable materials.

Specific soiling conditions include:

Airborne dirt
Tracked-in water and dirt
Tracked-in salt (in winter)
Greasy brakeshoe dust from train
Water brought in by wet trains
Materials discarded by subway users
Many varieties of Vandalism

Materials should be specified which, in event of damage, can be repaired or replaced without untoward disruption of station function, and without calling attention to repaired areas.

4) Environmental Effects

Materials and finishes shall be selected for environmental effect as seems most appropriate to the Station Architect, subject only to the following two requirements:

a) All colors shall be compatible with the Authority standard color coded graphics.

Walls and ceilings shall, in general, be light in tone, in order to decrease lighting costs by increasing reflectivity.

b) Certain repetitive station elements are required to be of particular materials or colors, in order to lend unity to the System as a whole, to solve particular functional problems, and to permit large scale purchasing. These elements are described under this Part Seven, and include the following:

1. Platform safety strip (Sheets C - 2 and C-2.1)
2. Doors and frames (Sheet C - 3)

For other standardized elements, see Part Four: Components and Part Five: Graphics.

5) Economy

Each material and finish proposed for use shall be subject to an informal cost benefit analysis, which will equate its advantages in light of criteria 1-4 above, with its initial and long term costs.

The criteria listed for materials and finishes pertain to both new stations and to modernized existing stations; however conditions in existing stations may preclude use of certain of the approved materials.

1) Space limitations: In many cases, existing corridors, stairways, and platforms will be found to be too narrow to accommodate new facing materials of any significant thickness. The height of platform above top of rail at existing stations being remodeled must be held as close as possible to the Authority standards. This restricts selection of floor finishes in cases where platform structure or track elevation cannot be altered.

2) Seepage: In some existing stations, uncontrollable seepage through walls and/or ceilings may necessitate the use of new cavity walls, built in drains, waterproofing treatments or other special materials or details. Correction and prevention of seepage is of primary importance. In new stations, seepage can be expected at certain locations, such as expansion joints, so drip pans and other methods of handling water should be built-into the station.

3) Void areas: If large areas of furred or closed-off space are required, these must be adequately vented and drained to prevent build up of leaking gas, water seepage and condensation. Furred ceilings must be capable of withstanding the positive pressure induced by passing trains.

4) Continuing operations: The necessity that existing stations be kept in operation during modernization will require that setting times of materials, and required protection be considered. In order to minimize overtime costs, prefabrication should be seriously explored.

5) Budgetary limitations: In certain less-busy stations, modernization will necessarily involve only improved graphics, lighting circulation and fare collection equipment, together with a minimum of surface repair and renewal. Limited budgets for these stations will require that the most economical acceptable materials be used.

EXISTING STATIONS - Special Conditions

The Station Architect may propose unlisted materials and finishes, submitting samples and technical information as may be required. These will be reviewed by the Authority for safety, durability, maintainability, economy, and environmental effect, as well as conformance to the system of standardized elements.

No strength tests for vandal resistance have been adopted, the serviceability of a given material being related to its particular situation. Proposed materials and finishes shall, in general, show no permanent discoloration when tested with methylene blue, lipstick, mercurochrome, or flet-tipped markers. Scratching with a jack knife should be very difficult, and not noticeably reduce resistance to discoloration.

REVIEW OF UNLISTED MATERIALS

The following types of materials are approved for use in the system, subject to the restrictions noted, and subject to Authority approval for each specific installation.

monolithic

Concrete granolithic topping
Bituminous concrete (track area only)

unit materials

Quarry tile
Paver brick
Slate
Heavy-duty rubber sheet or tile flooring
Unglazed ceramic tile (lavatories only)

(unit materials used in lavatories shall have joints of chemical-resistant grout)

APPROVED MATERIALS - Floors, Interior

The following types of materials are approved for use in the system, subject tothe restrictions noted, and, subject to Authority approval for each specific installation.

monolithic

Concrete - broom finish,
Heavy duty synthetic resin toppings
Bituminous concrete

unit materials

Paver brick
Slate
Granite Setts
Asphalt block
Precast concrete pavers

APPROVED MATERIALS - Floors, Exterior

The follwing types of materials are approved for use in the system, subject to the restrictions noted, and subject to the Director's approval for each specific installation.

monolithic

Concrete - smooth forms only (above vandal height only)

unit materials

Brick
Structural glased tile
Glazed ceramic tile
Architectural terra cotta
Natural stone - smooth faced, polished
Glazed brick
Procelain enamel
Non-corroding metals
Portland Cement plaster (above vandal height only)
Overlaid plywood (supervised areas only)
High pressure plastic laminates (supervised areas only)

(unit materials used in toilets must have joints of a chemical-resistant material)

surface finishes

Heavy-duty epoxy coatings
Inorganic glazed coatings
Heavy-duty standard paints (above vandal ehight only)

APPROVED MATERIALS - Walls, Interior

The folliwng types of materials are approved for use in the system, subject to the restrictions noted, and subject to Authority approval for each specific installation.

monolithic

Concrete - no restriction on forms

unit materials

Brick
Structural glazed tile - frostproof
Glazed ceramic tile - frostproof
Architectural terra cotta
Natural stone
Heavy-duty glass
Procelain enamel
Non-corroding metals
Acrylic or polycarbonate plastic (above vandal height only)
Pre-cast concrete
Weathering steel - use with caution

The following types of materials are approved for use in the system, subject to the restrictions noted, and subject to Authority approval for each specific installation.

monlithic

Concrete - smooth finish, unpainted preferred
Portland cement plaster - smooth finish, painted
Gypsum plaster - smooth finish, painted

unit materials

Prefab concrete
Wood fiber panels - painted
Panels of non-corroding metals

APPROVED MATERIALS - Ceilings

The folliwng types of materials are approved for use in the system, subject to the restrictions noted, and subject to the Director's approval for each specific installation.

1. Wall base
   Concrete - smooth finish, painted
   Terrazzo
   Rubber flooring coved to form base
   Glazed wall material (if of dark color)
   Troweled-on cement plaster
   Same material as wall or floor finish, such as brick, quarry tile

2. Stair treads
   Rubber bonded to stainless steel with saftey yellow edge for interior stairs
   Concrete, stone, for exterior stairs

3. Stair bases and risers
   Concrete - smooth finish, painted
   Sheet rubber

4. Hollow metal, Miscellaneous Iron and Steel
   Heavy-duty epoxy or nitrocellulose coatings
   Heavy-duty standard paints
   Baked-on enamel

5. Non-corroding metals
   Aluminum - visible parts shall be anodized, one half hour minimum
   Stainless steel - course brushed finish

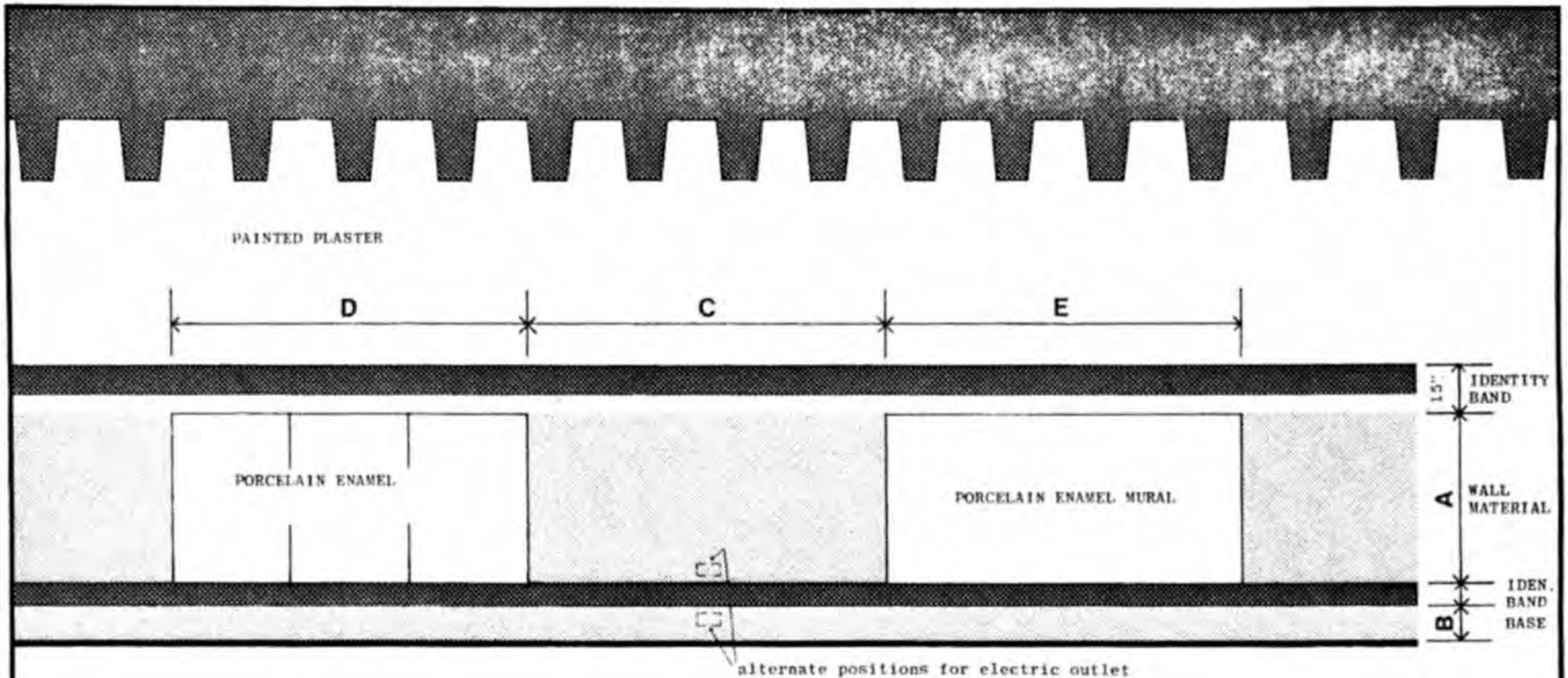
6. Safety strip at Platform Edge
   Troweled on abrasive coatings
   Heavy-duty floor paint
   Sheet rubber

7. Wood
   Heavy-duty paint
   Clear polyurethane varnish
   Stain - exterior locations

8. Caulking
   Polysulfide or silicone types where exposed to vandals.

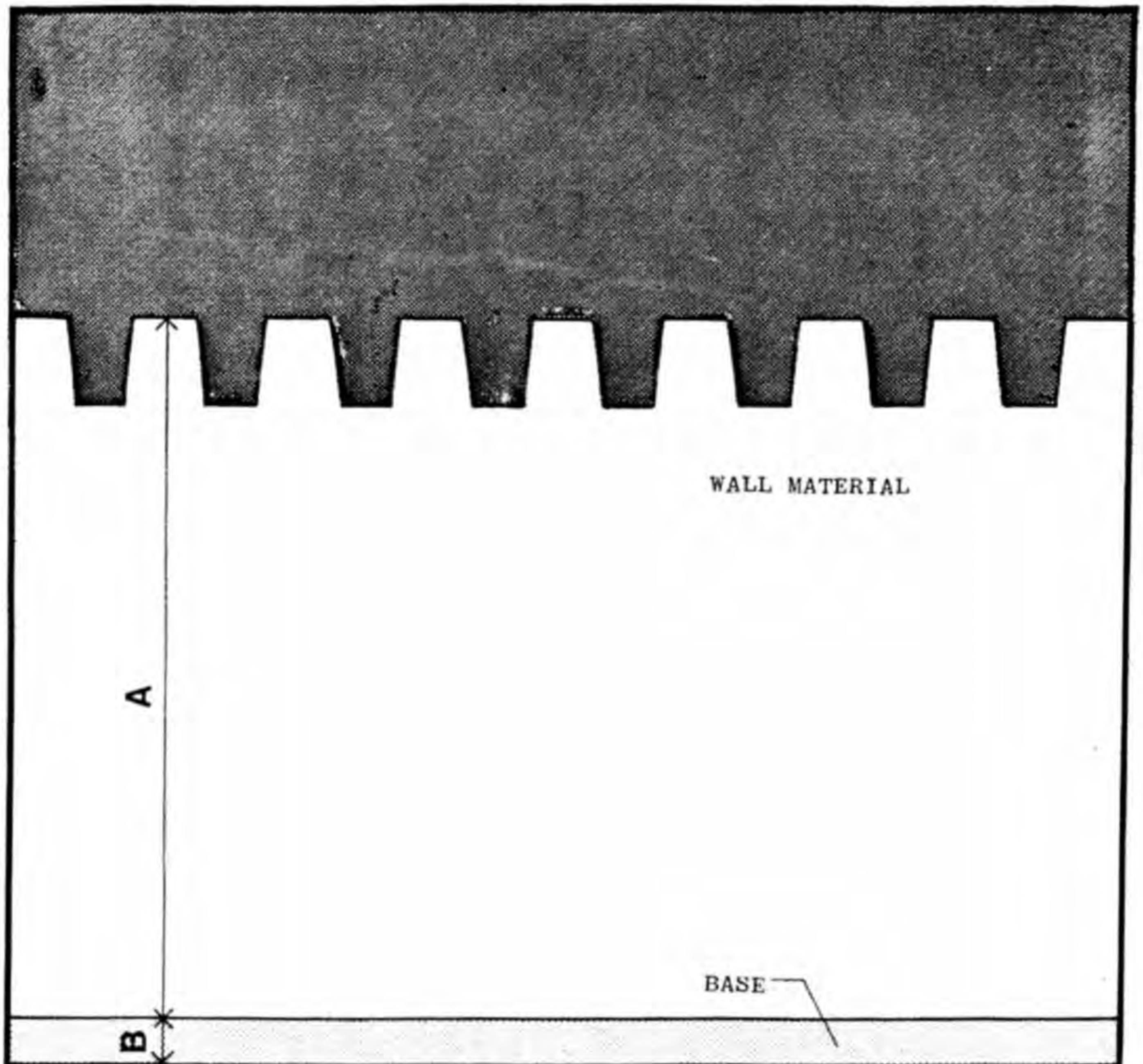
9. Hardware
   Chrome, stainless steel, anodized aluminum - all in brushed finishes

APPROVED MATERIALS - Miscellaneous Materials and Finishes



DIMENSION A:	Determined by placement of identity bands. Omit wall material behind murals and maps.
DIMENSION B:	Where platform pitches along station axis, set base height to fall between 4" minimum and 15" maximum. Failing that, step base at doors or changes in plane to conceal stepping as much as possible.
DIMENSION C:	Will vary with station.
DIMENSION D:	12' minimum, 16' optimum, See Part V.
DIMENSION E:	Will vary with Station, See Part V.

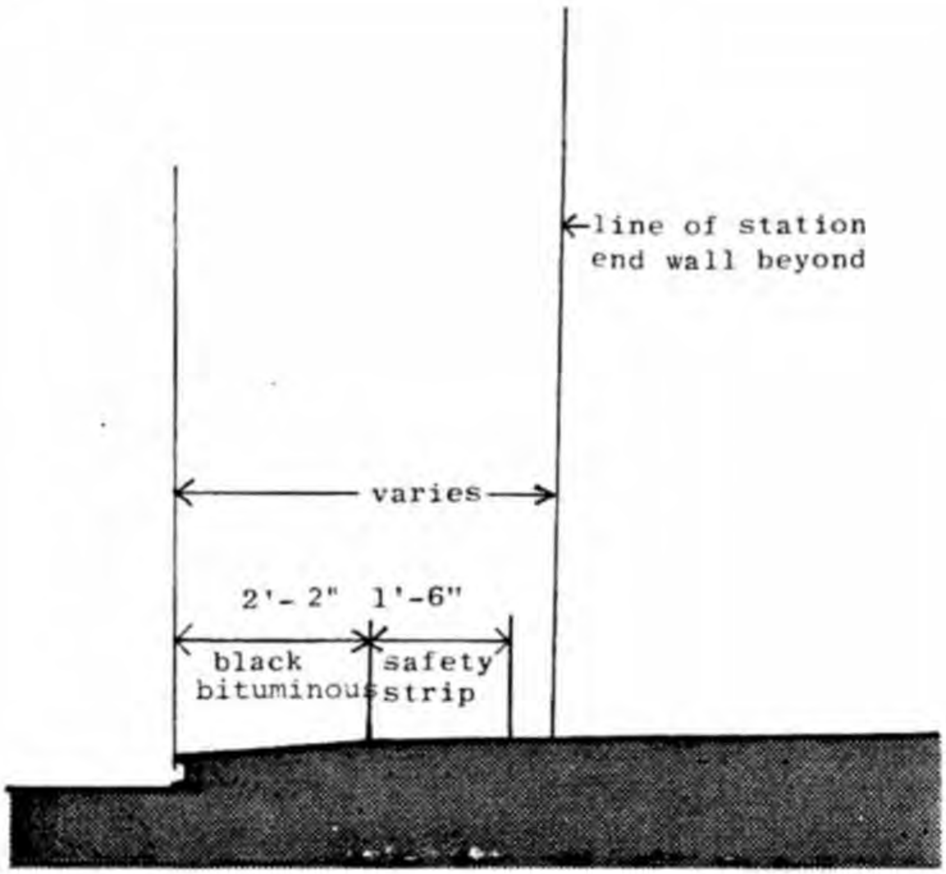
TYPICAL WALL AT PLATFORM



DIMENSION A: Varies, in low ceiling areas carry wall material over entire surface.

DIMENSION B: In general, keep base at constant height above floor, throughout any one space. If pitch or coursing forbids, treat base as at platform walls. Wall or floor material may also be used instead of a separate base material

TYPICAL WALL (OTHER THAN PLATFORM)

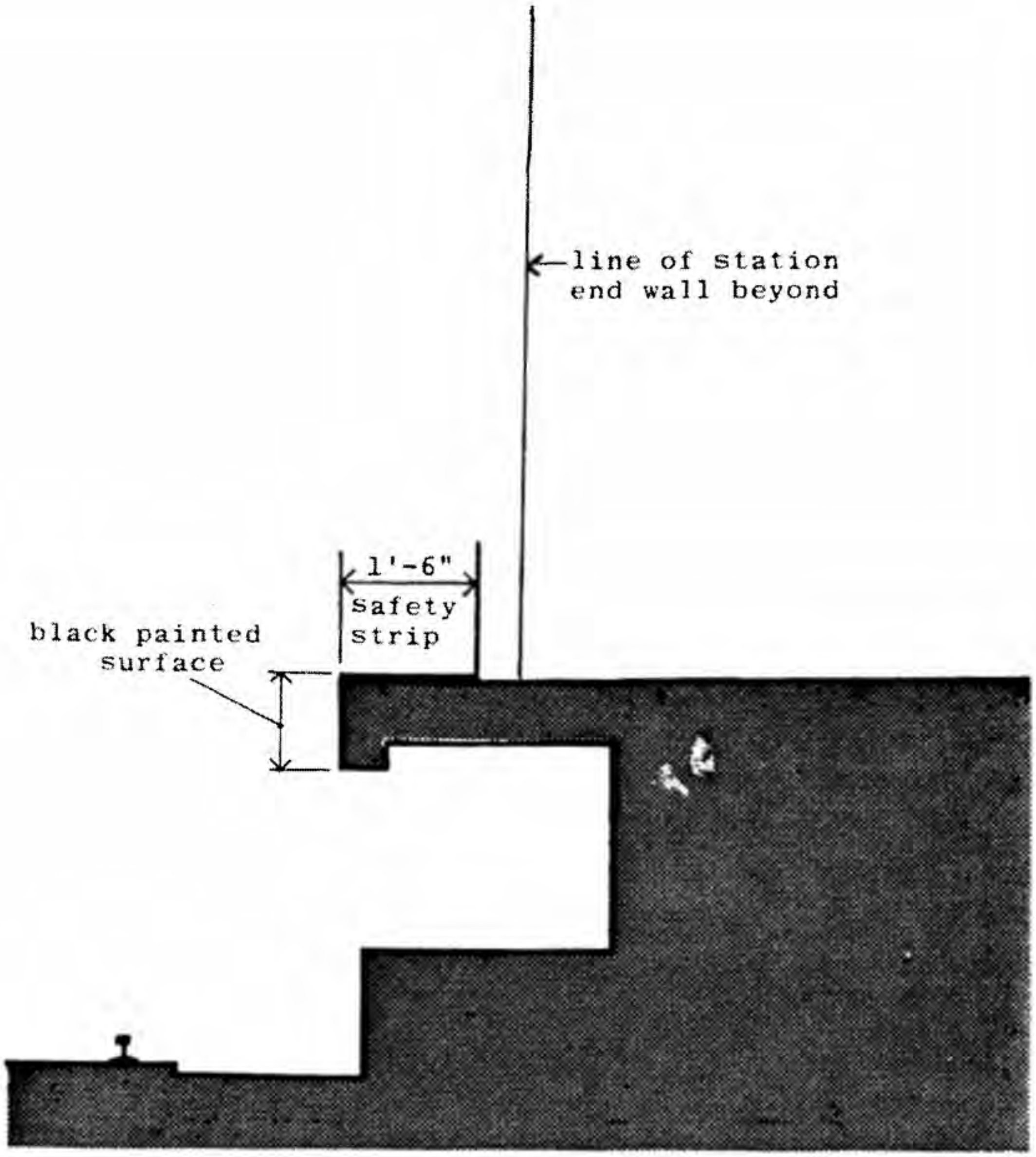


Safety Strip
Material : Heavy-duty abrasive coating
Heavy-duty paint, sheet rubber

Color: Safety yellow

Note that surface texture of yellow safety strip should contract with the platform finish to aid the blind.

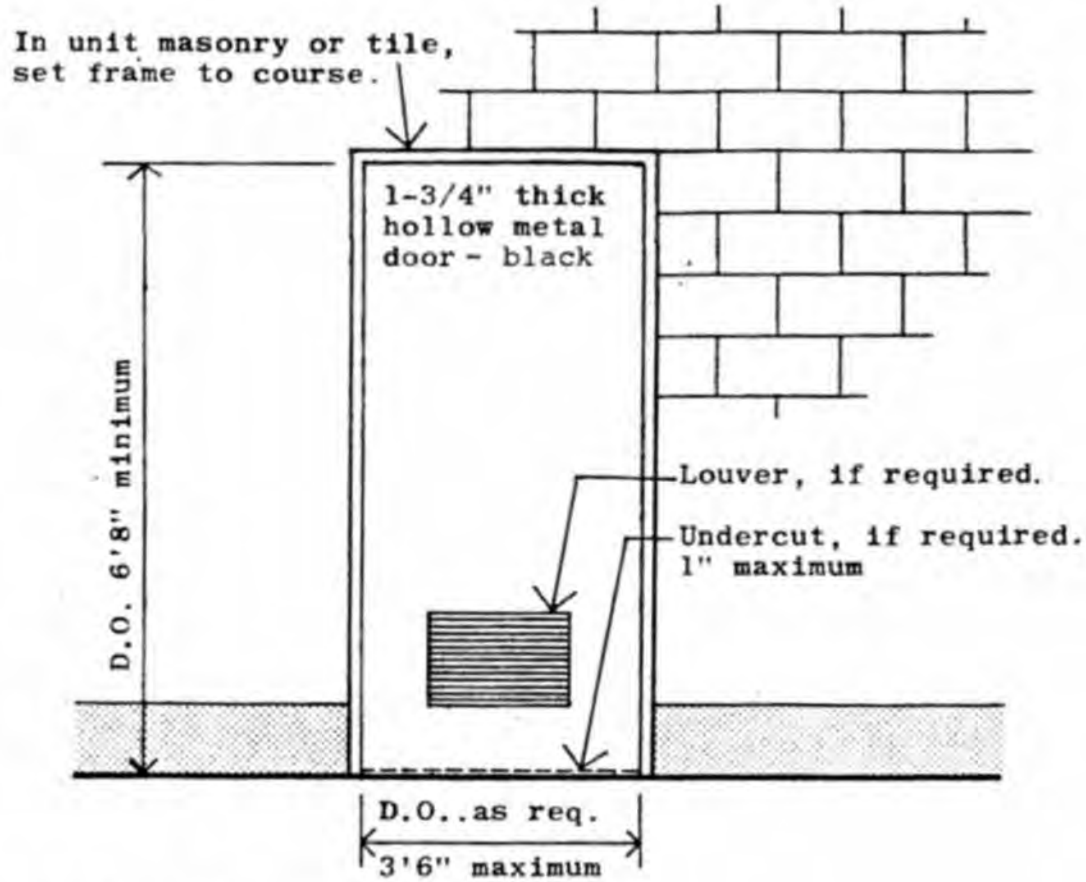
SAFETY STRIP AT PLATFORM
Streetcar lines

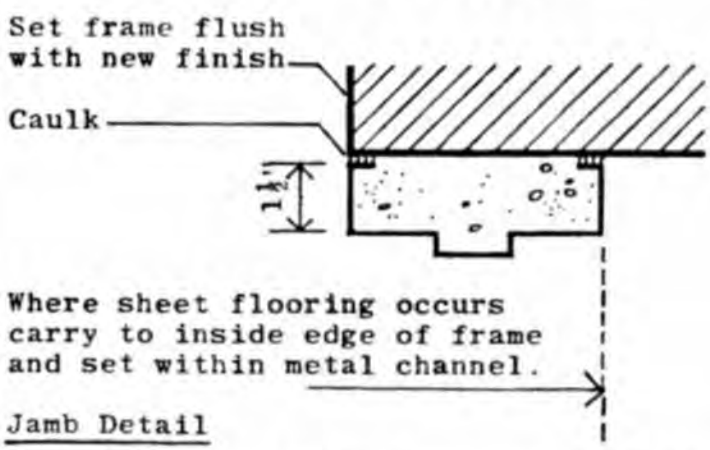


Material: Heavy-duty abrasive coating
Heavy-duty paint, sheet rubber

Color: Safety yellow

SAFETY STRIP AT PLATFORM
Rapid Transit Lines





Jamb Detail

Refer to Part IX for door requirements for each room. Master keying and required make of cylinder will be established by the Director for each station.

DOORS AND FRAMES - Service Rooms

In general, surfaces exposed to public contact are presently cald in some sort of heavy-duty glazed material that resists marking and damage, and permits easy maintenance. It is anticipated that such existing surfaces will be retained or replaced in kind and that new stations will be constructed of similar heavy duty materials. Acceptable materials are listed under Section A of this Part VII.

However, certain existing stations have public contact surfaces of painted plaster or concrete. Budgetary limitations may require that some of these stations not receive new glazed wall surfacings, but simply be re-painted. There are also stations for which final plans cannot yet be made, and which will be repainted in the interim. Finally, all stations will require a certain amount of painting of walls, ceilings, and structure above public ontact areas. This Section C establishes guidelines for use in all three of these cases.

The guidelines are based on four principles:

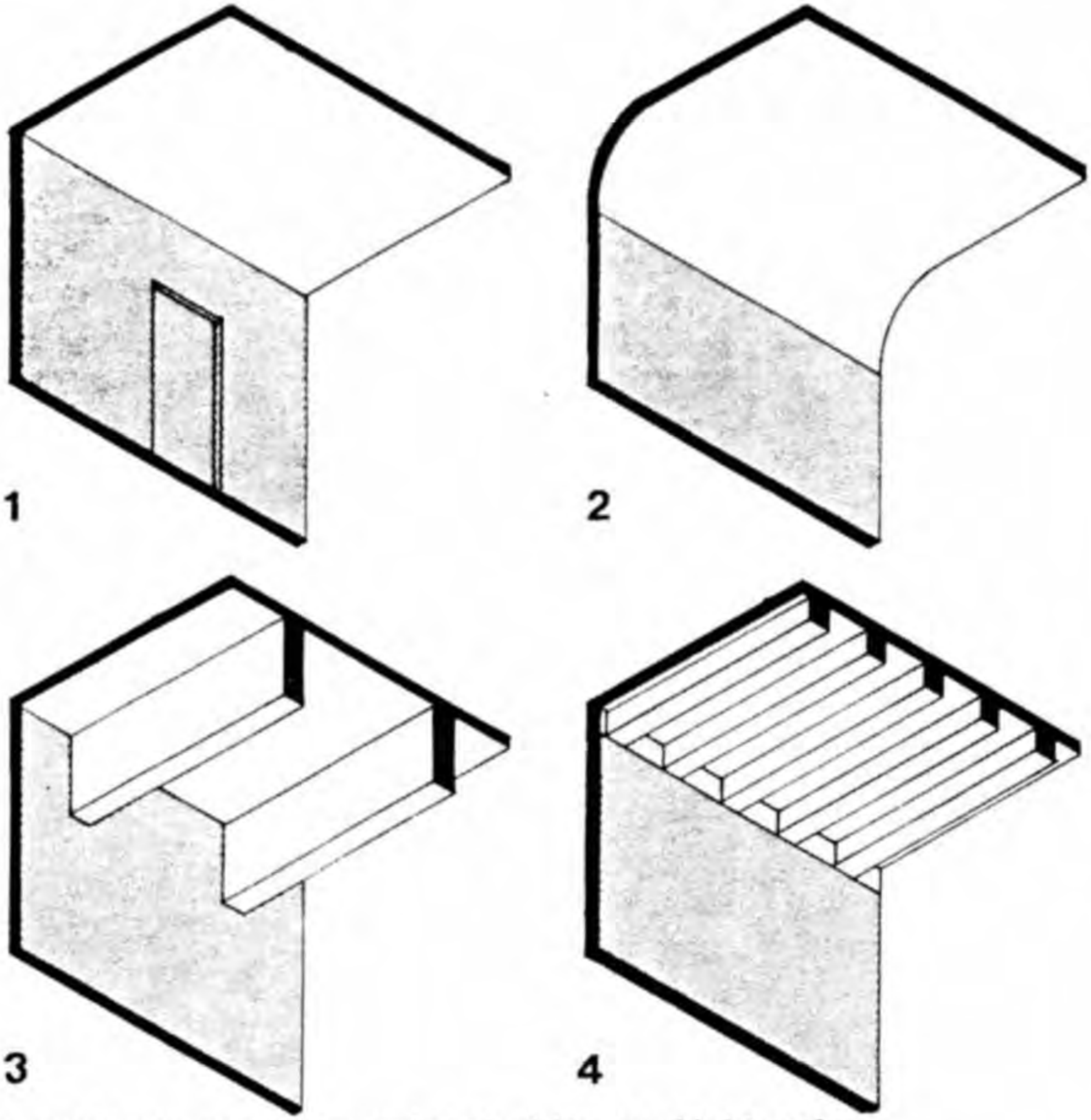
1. Major surfaces, structural members, and components should be painted colors -- which are compatible with the Authority standard color coded graphics.

2. Major surfaces, structural members, and components should not be cut into parts by color changes, except where absolutely necessary as at bases, or as other-wise noted hereafter.

3. Minor surface elements, such as conduit runs, etc., should be painted out with the surface. This treat-ment should be used, however, only where they cannot be removed, or relocated.

4. Visible diret-catching elements which are inaccessi-ble for cleaning should be painted dark to minimize the effects of soiling.

GENERAL PRINCIPLES

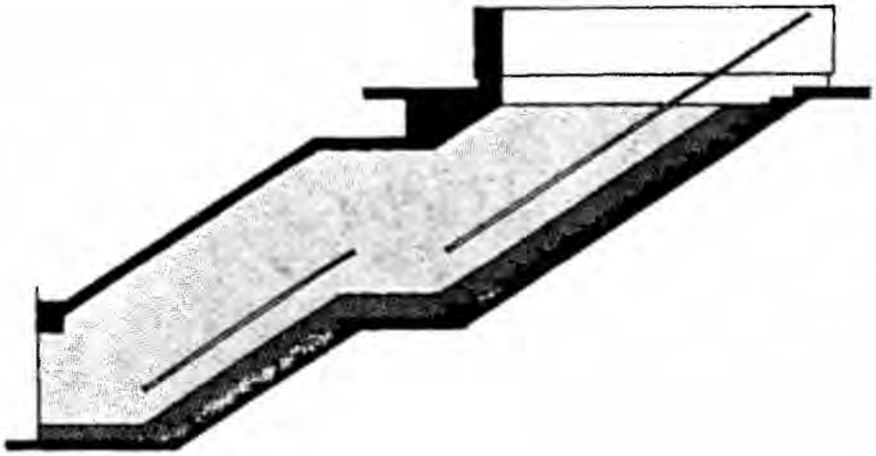


All ceilings are to be painted white or light color.

All walls exposed to public contact are to be painted with heavy dutey paint or approved synthetic coating.

1. Color change occurs at intersection of two planes. Doors to service rooms are to painted black.
2. Wall color stops at spring line.
3. Wall color continues between wide-spaced beams.
4. Wall color stops at underside of closely-spaced beams.

MAJOR SURFACES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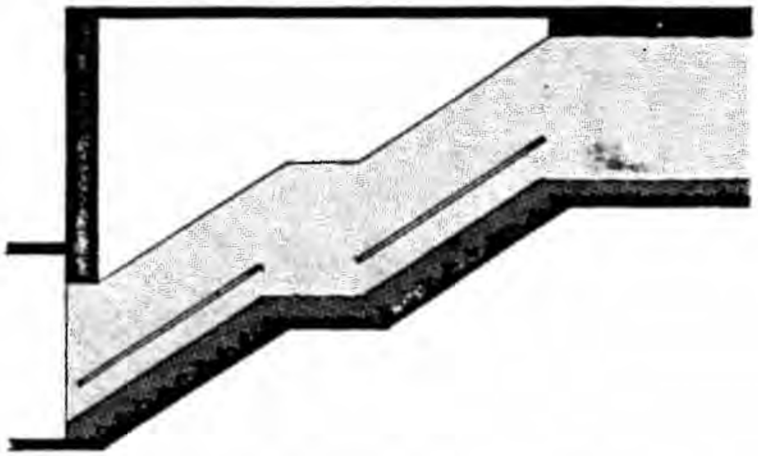

2

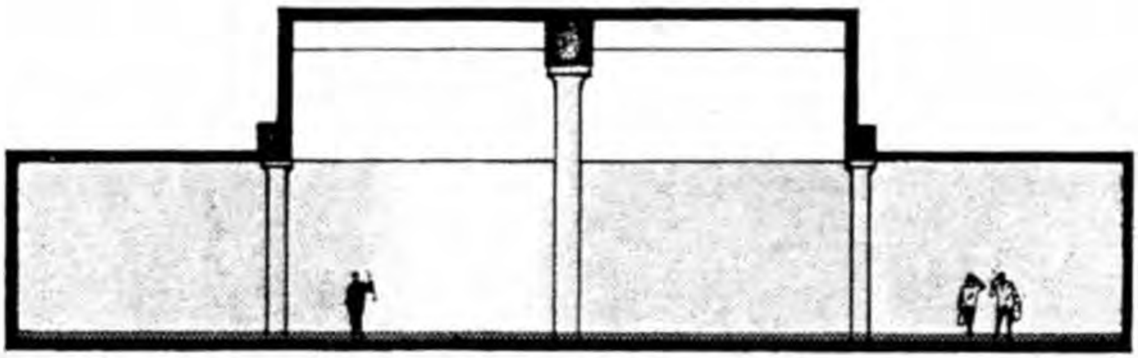
All exposed walls on stairways are to be painted with heavy duty paint or approved synthetic coating.

1. Wall color terminates at exterior finish materials.
2. At very high walls above stairways, the wall color can be held down to a high wainscot running parallel to the stair slope. Wainscot height will be determined by actual conditions, but must extend above normal public contact.

MAJOR SURFACES

1

2

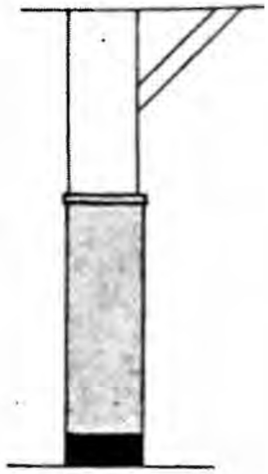


All walls above normal public contact are to be painted a light color.

1. At trackpits the wall color is to extend down to the level of the platform. Below this line the wall, including niches, is to be dark gray.
2. At extremely high walls, the wall color is to terminate at a line above normal public contact, and a light color used above this line. The particular station configuration will determine the exact location of this line.

MAJOR SURFACES

1



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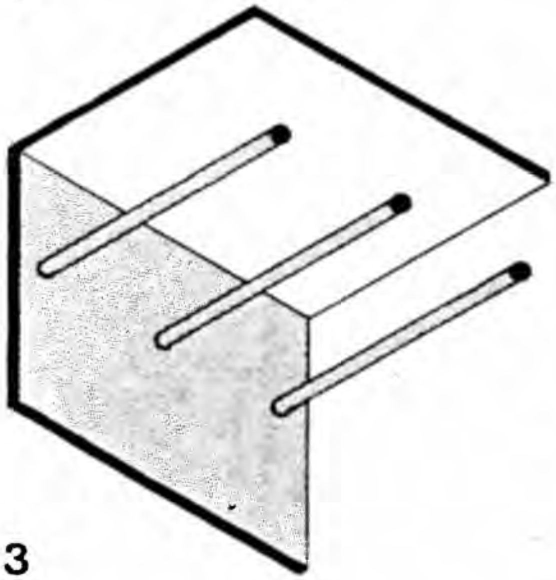

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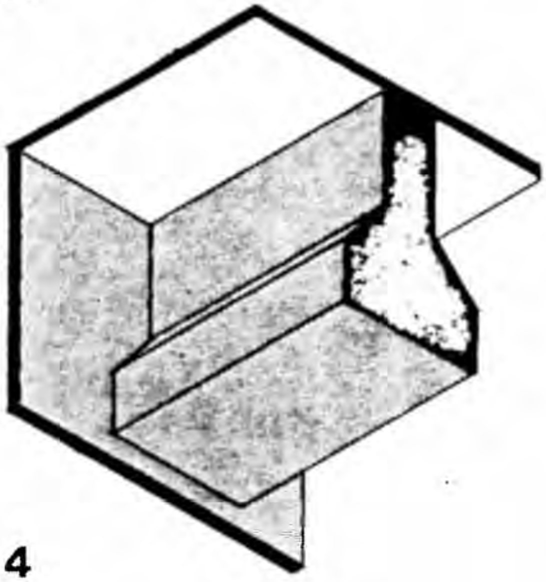

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1. Columns are to be painted with wall color full height including capital.
2. Exception: when column is partially sheathed, the part above the sheath is to be painted another color.
3. Tie rods are to be painted wall color.
4. Members with horizontal dirt catching surfaces within public view are to be painted wall color.

STRUCTURAL MEMBERS

1. Where practicable, existing wood benches and existing handrails may be sanded down, and re-finished in heavy duty varnish.

2. All components are to be painted black. Where they are exposed to public contact, the paint shall be a heavy duty type, or an approved synthetic coating.

For painting purposes, the following are to be regarded as components.

Free-standing collection booths (types presently in use, only)
Turnstiles (types presently in use, only)
Exit gates (types presently in use, only)
Rotary Coinpassers (types presently in use, only)
Fences and Guardrails
Commerical facilities, not including factory finished telephone booths and lockers
Advertising frames
Exposed switch boxes and panel board enclosures
Exposed fire hose cabinets
Exposed sand and salt boxes
Metal stairs
Bases of existing benches

COMPONENTS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GUIDELINES AND STANDARDS
PART VIII
ACOUSTICS
REVISED 1977

MANUAL OF GUIDELINES AND STANDARDS

GENERAL INTRODUCTION

The Massachusetts Bay Transportation Authority has found it both necessary and possible to concentrate attention on the complex needs of people. Programs to improve service must now include a new emphasis on the quality of the transportation experience. In effect, transportation engineering has been joined by human engineering and environmental design.

This manual provides a framework for the continued coordination of all those elements in the system that affect human comfort.

Many of the criteria involved are common to all environments, such as the control of light, noise, humidity, temperature, wind, and odors, or the need for orderliness, through clear and easy circulation and clean appearance. Other criteria that are more specific to the transportation environment are such needs as safety, traffic handling capability, spatial variety, consistently available information, and orientation.

The most important single criterion that has guided the preparation of this manual is the need for orientation. The rider must not only be physically comfortable, he must also know in the fullest sense where he is and where he is going.

Since to the layman a public transportation system is to a large extent an invisible skeleton of the city and metropolitan region, the comprehension of that structure generates an awareness and appreciation of the city itself, and an appreciation of travel through it.

There are many aspects to achieving this orientation. Circulation at all points must be direct and open. Spaces should relate visually to their surrounding environment, either through direct openings to adjacent spaces and structures, or in the case of platforms, by graphic reflection through photographic murals.

Above all, the need for orientation places great emphasis on maps and a consistent system of identification and directional signing. Graphics then emerges as a major factor in the design of each environment, a factor that must be given high priority in the early design phases of each project.

It is hoped that all participants in all programs will familiarize themselves with the entire manual, so that the implications of each decision can be understood in a system-wide context.

The standards and guidelines presented here are not inflexible rules. They are a framework for meaningful development and variety, and offer no restriction to the capacity of each participant to evolve better solutions to old or new problems.

As new solutions are developed and approved, revised and additional pages for the manual will be issued to all participants.

INTRODUCTION

Part VIII of the Manual provides the designer with a brief discussion of: the rail transit noise environment, suggested noise criteria, and possible approaches to noise abatement in stations and along the right-of-way. The primary purpose is to make the designer sufficiently aware of the scope of the problems and their possible solutions, to insure that proper attention and resources are devoted to this area in the design process.

Rail transit noise affects three groups of receivers (persons subjected to noise): persons waiting in stations, persons along the right-of-way, and persons on the trains. This volume will deal primarily with those aspects of noise environment and control which affect the various receivers, which lie within the province of the station and facility designer.

This section supersedes the entire ACOUSTICS Section of the original issue of the Manual of Guidelines and Standards.

PART VIII. ACOUSTICS

A. The Rail Transit Noise Environment

The subject of noise and means of controlling it are covered in considerable depth in text books and technical reports in the field of acoustics. The purpose of this section is to give the designer some basic background in acoustics as applied to rail transit noise problems. There are many popular misconceptions about noise and its control, and hopefully some of these may be disposed of.

1) Noise and How It Is Measured

- Noise, which really means a disagreeable sound, consists of rapid fluctuations of pressure, which travel outward from the source through the atmosphere, to a location where they are detected by the ear.
- Noise, or pressure fluctuations, are created by a vibrating object, such as a violin string or a moving railroad car wheel.
- Noise is measured in decibels, giving an indication of the sound pressure level, on a logarithmic scale. This is done because of the wide range of sound pressure levels.

- The frequency of the pressure fluctuations determines the pitch of the sound with higher frequencies corresponding to higher pitch sounds.
- As the ear responds differently to varying frequencies, measuring devices called sound level meters can be compensated for this electronically to give the "loudness level" or "noise level" in decibels in the A scale, normally expressed as dBA. This is a reasonable approximation of loudness of a sound as heard by the average person, and will be used throughout this report, except where otherwise noted.
- A change in noise level must be at least 5 dB to be definitely perceptible to the average person.
- A change in noise level to 10 dB is equivalent to an apparent doubling, or reduction by one-half, of a sound.
- A very low noise level, such as a soft whisper at a distance of 5 feet is 34 dBA, an average residential area at night has a noise level of 40 to 45 dBA, while inside a factory, punch presses may create a noise level of over 110 dBA. Normal conversation is at a level of 60 dBA.

2) <u>The Characteristics of Rail Transit Noise</u>

Rail transit noise must be discussed from the standpoint of its:

- Sources, Paths and Receivers
- Loudness or "Sound Power"
- Frequency Content

All of these must be considered by the designer in order to define the problems and develop their solutions.

a) <u>Sources, Paths, and Receivers</u>:

<u>Sources</u>:

Rail transit noise and vibration is greatest by a number of primary sources, with the most dominant one originating at the interface between wheel and rail. Other sources of noise radiation are equipment installed on vehicles or the wayside. The primary sources are as follows:

- Wheel-on-rail noise which includes that caused by:

  Rolling

  Side slippage of the wheel across the railhead

  Wheel slippage across and along the railhead on curves

  Wheel flange bearing on the restraining rail and side of the running rail

  Impact at built-in irregularities such as rail joints, switch and crossing frogs

Impact at rail defects such as rail corrugation, burns, or cracks

Impact at wheel defects such as flats and spalling

- Current Collector noise which includes that caused by:

  Sliding of the collector over the 3rd rail or overhead trolley

  Impact at irregularities such as ramps at rail ends and joints

- Vehicle-mounted equipment noise which includes that caused by:

  Traction motors (windage and bearings)

  Gears

  Brake shoes bearing on wheel treads, discs or rail surface

  Air compressors

  Motor-generator or alternator sets

  Air Conditioning condensor and ventilating fans and refrigerant compressors

  Flourescent light ballast

  Doors (operator noise plus bangs and rattles)

  Couplings, and Pantograph Gates (rattles)

  Brake valve air venting

  Ventilation ducts, inlets, outlets, and louvers

  Vehicle slip-stream

- Structure borne paths which include:

  Vehicle suspension system

  Auxiliary equipment suspension system (on vehicles)

  Vehicle structure

  Track and station supporting structure

- Ground borne vibration path

Certain paths for the transmission of noise and vibration may in turn become radiators of audible noise. These secondary radiators include:

- Vehicle walls and ceilings
- Bridges and viaducts
- Station structures
- Adjacent building structures

Receivers:

The receivers of rail transit noise and vibration include:

- System users and employees on trains and in or around stations
- Wayside community

These receivers may be effected by noise and vibration in a number of ways:

- Wayside equipment noise which includes that caused by:

  Ventilating fans

  Ventilating shafts (moving air noise and train noise)

  Substation transformers (60 hz hum)

  Substation rotary converters

  Pumps and ejectors

  Switch machines

  Fare collection equipment

  Escalators

  Air conditioning equipment

- Other sources including people, motor vehicles, buses, airplanes, etc., which effect the acoustical environment of the transit system user

<u>Paths and Secondary Radiators</u>:

The paths between source and receiver include the following:

- Airborne paths which include:

  Directly radiated sound

  Reflected sound

  Reverberation in tunnels

  Reverberation in stations

  Reverberation in vehicles

- Psychological effects including annoyance and interference with conversation, rest, and work performance
- Physiological effects including discomfort, temporary or permanent hearing loss, and other general effects on health
- Economic effects such as decreased property values or interference with commercial activities

These effects in combination can help create an image of the rail transit system which discourages its ridership and community acceptance.

b) Loudness or "Sound Power of Noise":

Investigation of the acoustical environment normally begin with measurements of the loudness of the sounds, or "sound power" (sound pressure level). Some typical noise levels and characteristics of transportation noise are described below.

- Comparison of average peak noise levels generated by modern transportation vehicles, measured at a distance of 50' (from center of vehicle), out of doors at ear level, with speeds of 35 to 50 mph, are as follows:

Automobiles in traffic	70 to 80 dBA
Two Car MBTA Rapid Transit Train on surface track with welded rail	81 to 91 dBA
Diesel Bus	80 to 88 dBA

Heavy Truck	88 to 92 dBA
Diesel Locomotive	90 to 104 dBA
Passenger and Freight trains excl. locomotive	83 to 96 dBA

- The effect of speed on noise generated by rapid transit trains running in the normal range of operating speeds (above 35 mph) is as follows:

  Increase of speed by 25% increases noise by ≠3.5 dB

  Increase of speed by 50% increases noise by ≠5 dB

  Increase of speed by 100% increases noise by ≠9 dB

- The number of cars in a train makes slight difference in the apparent loudness - at 50 ft. from the tracks and a speed of 45 to 50 mph doubling from 2 to 4 cars increases the noise by ≠2 dB. One also hears the noise for a slightly longer time.

- Doubling the distance from the train will reduce the noise level by ≠3 dB for distances less than 1/3 the train length, and by ≠6 dB for distances greater than 1/3 the train length.

Wayside noise levels measured by DOT Transportation Systems Center (TSC) at various residential areas along surface and elevated sections of "T" rapid transit lines at distances from 50 to 100 feet from the line are as follows:

(1) Blue Line 84 to 89 dBA

(2) Orange Line 88 to 100 dBA

(3) Red Line 80 to 92 dBA

The range of noise level at wayside at 50 ft. was found to be 80 to 95 dBA, in stations 80 to 95 dBA, and in the cars 70 to 95 dBA. These are judged to be typical of rail rapid transit systems in the U. S.

Noise levels measured by TSC on the Red Line South Shore Extension near Tenean Street on April 1972 were as follows:

	Train Length	Speed	Peak RMS Noise Level in dBA at 25 ft.	at 50 ft.	at 100 ft.
Range:	2 car	47.4 to 51.3	74 to 100	81 to 96	73 to 90
Average:	2 car	49.9	89.5	86.5	79.8
Range:	4 car	48.6 to 56.4	87 to 102	82 to 97	77 to 90
Average:	4 car	50.1	95.2	88.4	83.6

These measurements were made on welded rail on concrete ties. Due to excessive wheel flats and wheel spalling they are at least 5 dB higher than would be expected with this type of equipment and road-bed. (Installation of a modern wheel-truing machine in the new South Bay shop will cause a major improvement in this area.)

c) Frequency Content of Noise:

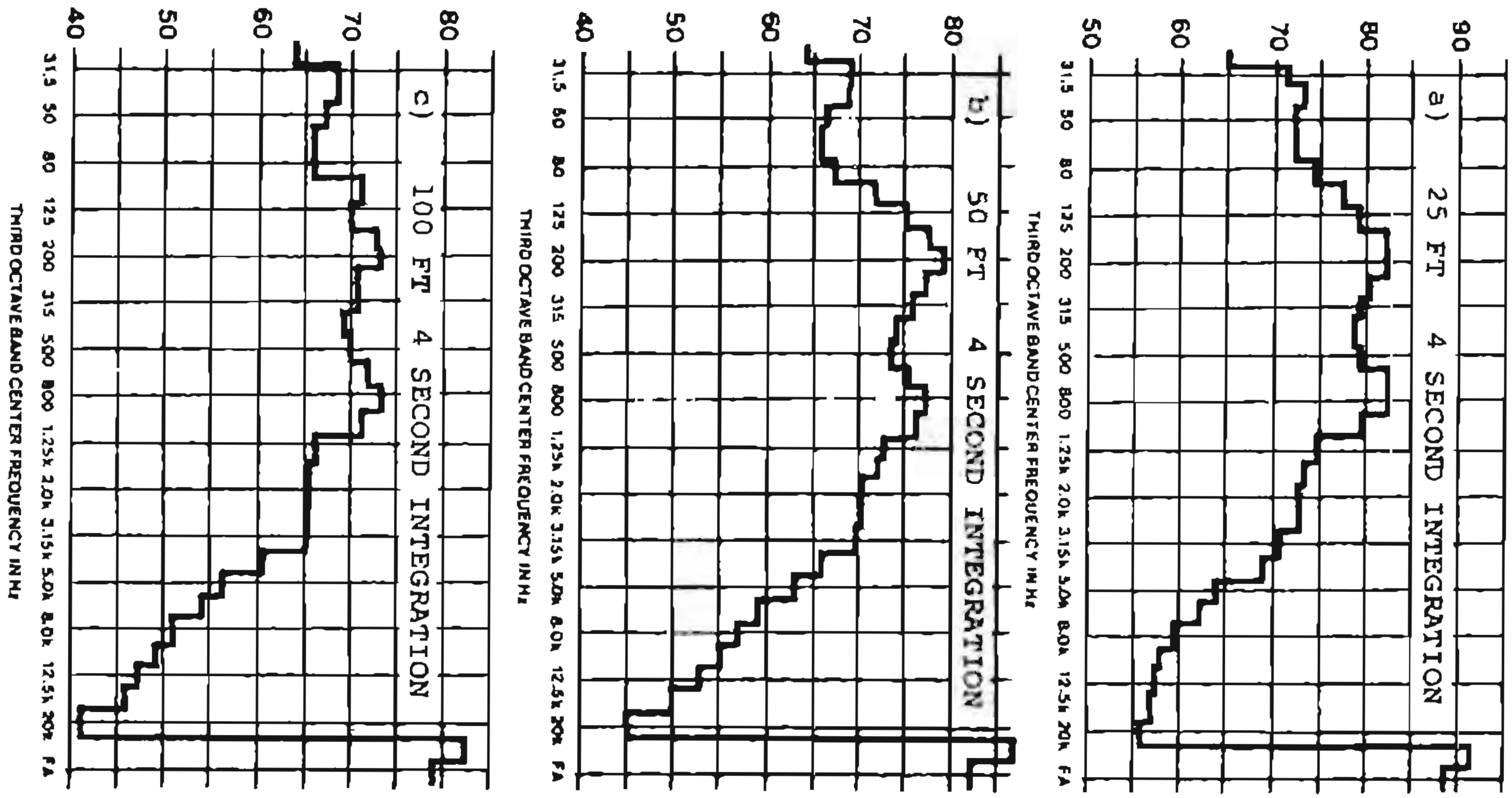
The loudness or level of noise as expressed by the A-weighted level does not give sufficient information to the designer when

methods of noise abatement are under detailed study. It is necessary to consider the frequency content of the sound. Normally these are plotted by one-third octave band center frequencies. Typical wayside noise spectra for the South Shore Line measurements are shown on Figure 1 and 2.

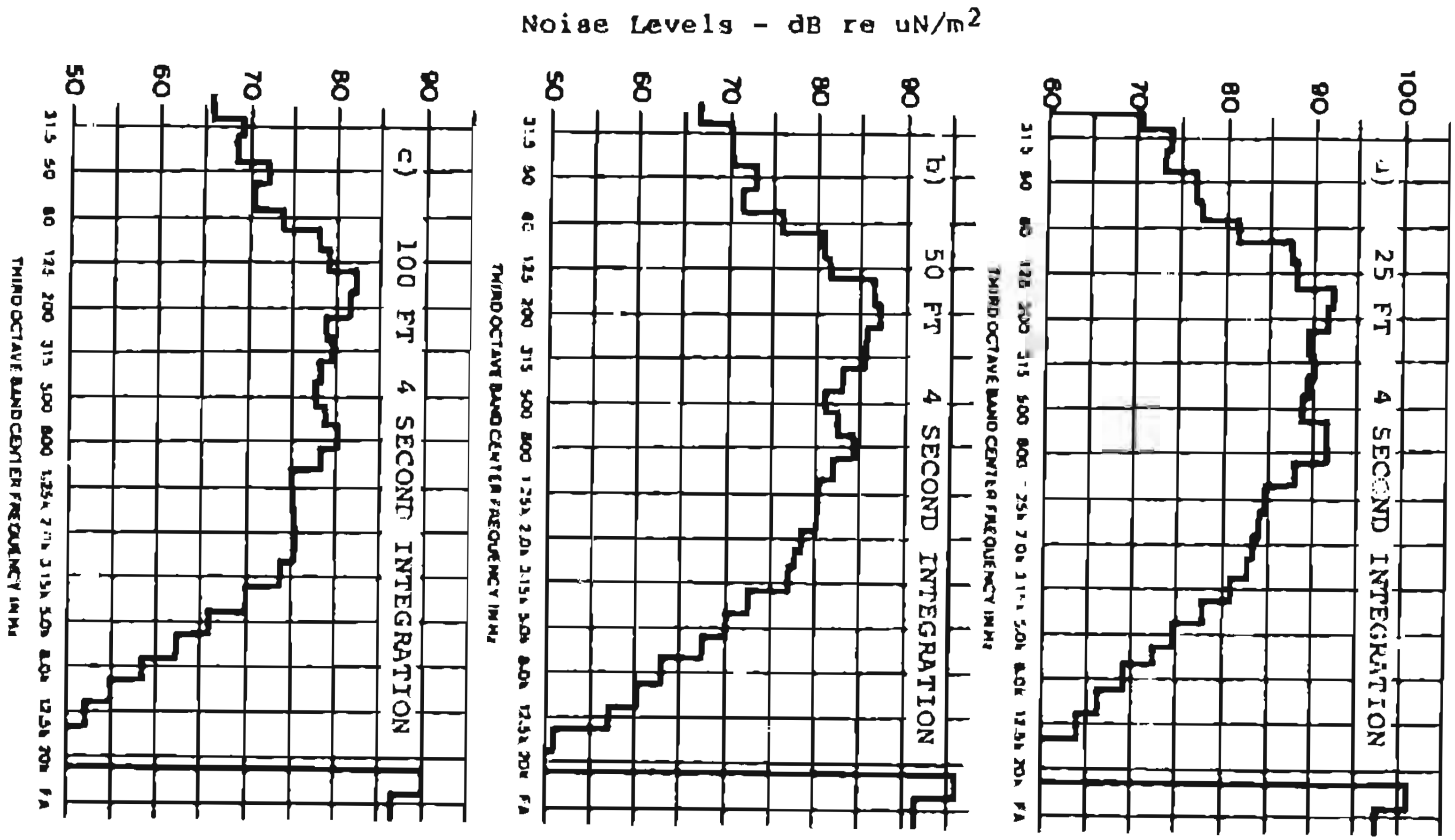
When dealing with specific problems such as wheel-squeal, frequency analysis is particularly important. Measurements made at Government Center subway station are shown on Figure 3. Note the very intense peaks at the high end of the scale.

The designer may require analysis of this type, as well as other more extensive measurements and analyses of noise and vibration to solve the problems of individual location.

Noise Levels - dB re 20 N/m^2



Wayside Noise Spectra at 25, 50, and 100 ft. from centerline of northbound track. MBTA Red Line (So. Shore Extension) April 27, 1972. 2-Car Train northbound, Ser. Nos. 1503, 1506 at 49.5 mph.



Wayside Noise Spectra at 25,50, and 100 ft. from centerline of northbound track. MBTA Red Line (So. Shore Extension) April 27, 1972. 4-Car Train northbound - Ser. Nos. 1503, 1506, 1611, 1610 at 49.7 mph.

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ACOUSTICS VIII

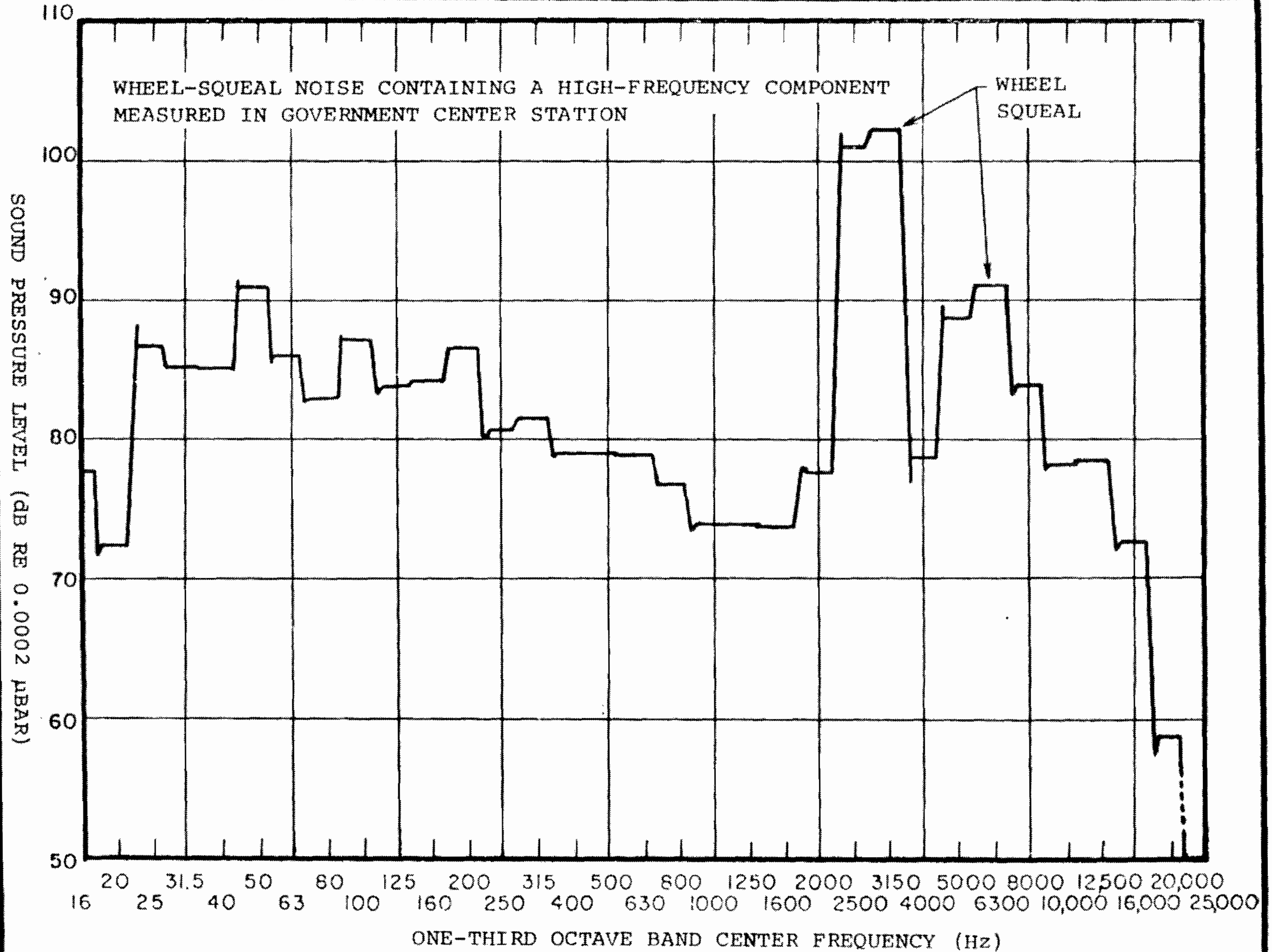

Figure 3

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3) Noise at Stations

Noise level on station platforms varies with the type and condition of equipment and roadbed, maximum speed of trains entering and leaving the station, to what degree the station is enclosed (subway station versus un-roofed surface station), the nature of the enclosing surfaces, and the configuration of the track geometry approaching and within the station.

The preliminary report "Rapid Transit Noise Assessment and Abatement/Cost Requirements" by U. S. DOT Transportation Systems Center (TSC) of March 1973 covers a measurement program done on MBTA rail rapid transit lines. It describes station noise as follows:

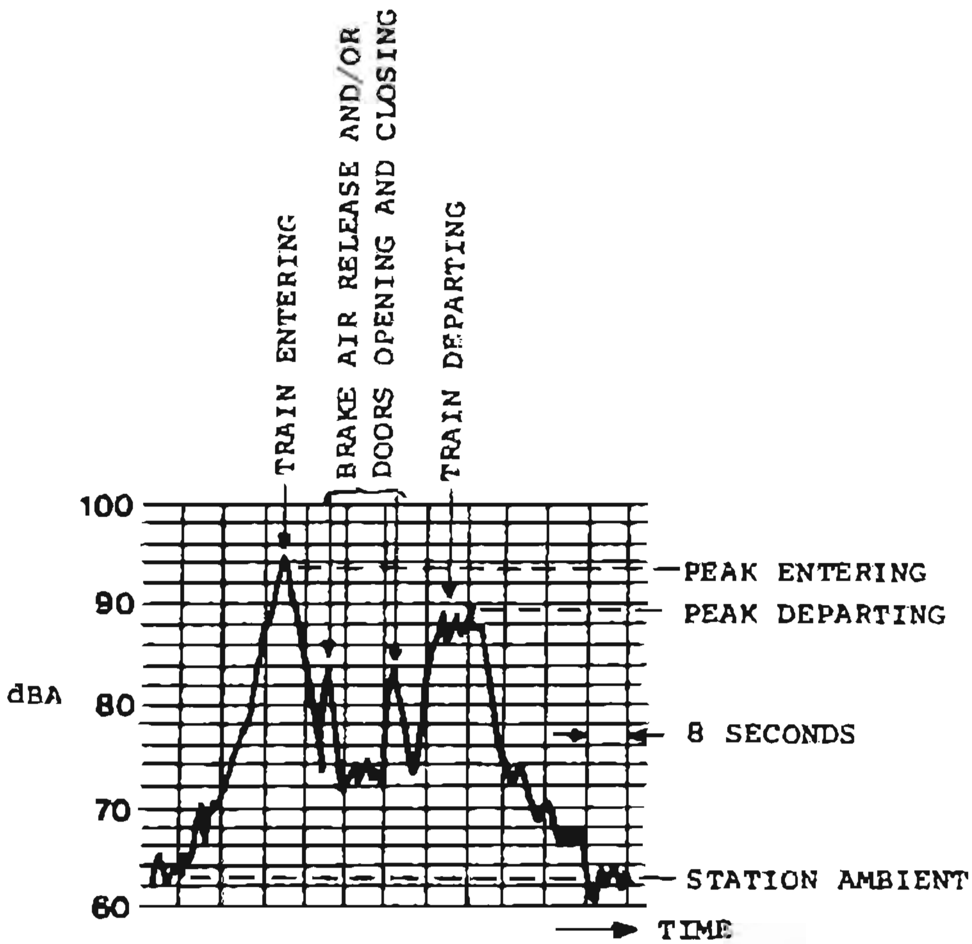
"In the absence of any train, waiting patrons hear ambient noise due to station machinery and, if the station is above ground, from traffic and aircraft. As a train arrives the awaiting patrons hear low frequency noise. Usually the noise level reaches a peak in about six to eight seconds and drops rapidly during the next several seconds to a rough noise plateau as the train stops. Frequently, the mechanical tread-braking produces a short screech prior to the stop. In the worst cases, the following effects then occur in rapid succession: (1) Door slam; (2) Brake air release hiss; (3) auxiliary equipment such as ventilation and motor-generators produce a steady noise. As the train departs another sequence of door slam and brake hiss noises

occur followed by the low frequency rumble of the departing train." This sequence of events is shown on Figure 4.

A comparison of subway station platform noise levels for various rail transit systems is shown below:

TABLE SUBWAY STATION PLATFORM NOISE LEVELS

Car Type	Passby Speed and Conditions	Noise Level
BART	0 mph	63-64 dBA
	20	77
	40	87
	55	90
	Entering & Leaving	70-75
TTC	Entering & Leaving -	
	No acoustical treatment	85-91
	With acoustical treatment	70-80
PATCO Lindenwold	Entering & Leaving -	
	No acoustical treatment	79-89
Paris Metro New Steel Wheel	20 mph	75-82
	40	89-91
	Entering & Leaving	80-86
Paris Metro Rubber Tire	20 mph	73
	40	86
	Entering & Leaving	80-85
Paris RER	Entering & Leaving	70-80
CTA	Tunnel Stations with Concrete Trackbed	103-110
	Subway Stations with Ballast & Tie Track	90-95
MBTA - high platform lines	Entering & Leaving	84-93



Sample Time History of Station Platform Noise Levels (dBA)

The TSC measurement program in Boston included platform noise level measurements in eighteen of the forty-four stations of the three rapid transit lines. In some cases continuous recordings were made and in others a series of rapid hand held meter readings were obtained. The microphone or meter was placed about ten feet back from the platform edge at a typical waiting location. The average of the arriving and departing peaks in the A-weighted sound levels was chosen as a simple measure of the severity of noise in stations.

Based on the measurements, noise levels were estimated for all the remaining stations on these lines. Measured and estimated values are shown below:

a) Blue Line

Station	Type	Avg. of Entering & Leaving peaks (dBA)	Ambient Level (dBA)	Comments
1. Bowdoin	Subway	90	55	Measured
2. Govt. Center	Subway	89	62	Measured
3. State	Subway	90	55	Measured
4. Aquarium	Subway	85	45	Measured
5. Maverick	Subway	88	53	Measured
6. Airport	Surface	90	58	Measured
7. Wood Island	Surface	88-92	-	Estimated
8. Orient Hghts.	Surface	83-87	-	Estimated

9. Suffolk Downs	Surface	92	54	Measured
10. Beachmont	Elevated	88-92	-	Estimated
11. Revere Beach	Surface	88-92	-	Estimated
12. Wonderland	Surface	88-92	-	Estimated

b) <u>Orange Line</u>

Station	Type	Avg. of Entering & Leaving peaks (dBA)	Ambient Level (dBA)	Comments
1. Everett	Surface	78-82	-	Estimated
2. Sullivan	Elevated	83-87	-	Estimated
3. Thompson	Elevated	78-82	-	Estimated
4. City Square	Elevated	83-87	-	Estimated
5. North Sta.	Elevated	87	66	Measured
6. Haymarket	Subway	83-87	-	Estimated
7. State	Subway	83-87	-	Estimated
8. Washington	Subway	84	60	Measured
9. Essex	Subway	87	55	Measured
10. Dover	Elevated	78-82	-	Estimated
11. Northampton	Elevated	78-82	-	Estimated
12. Dudley	Elevated	80	64	Measured
13. Egleston	Elevated	78-82	-	Estimated
14. Green	Elevated	78-82	-	Estimated
15. Forest Hills	Elevated	78-82	-	Estimated

c) Red Line

Station	Type	Avg. of Entering & Leaving peaks (dBA)	Ambient Level (dBA)	Comments
1. Harvard	Subway	88-92	-	Estimated
2. Central	Subway	93-97	-	Estimated
3. Kendall	Subway	93	55	Measured
4. Charles	Elevated	83-87	-	Estimated
5. Park	Subway	89	62	Measured
6. Washington	Subway	88-92	-	Estimated
7. South Sta.	Subway	88-92	-	Estimated
8. Broadway	Subway	88-92	-	Estimated
9. Andrew	Subway	90	62	Measured
10. Columbia	Surface	83-87	-	Estimated
11. Savin Hill	Surface	85	72	Measured
12. Fields Corner	Surface	83	50	Measured
13. Shawmut	Subway	88-92	-	Estimated
14. Ashmont	Subway/Surf.	88-92	-	Estimated
15. North Quincy	Surface	83-87	-	Estimated
16. Wollaston	Surface	83-87	-	Estimated
17. Quincy Ctr.	Subway	83-87	-	Estimated

The noise level for MBTA high platform subway stations was measured or estimated within a range of 84 to 93 dBA, surface stations 78 to 92 dBA, and elevated stations 78 to 87 dBA.

A study by Bolt Beranek and Newman "The Acoustical Treatment of Stations to Alleviate Wheel-Squeal Noise" of October 1970 included measurements at 3 Green Line subway stations where small radius curves created extreme noise levels:

1.	Government Center:	93-105 dBA	Entering Southbound
		97-109 dBA	Leaving Southbound
2.	Park Street:	95-114	Entering Southbound
3.	Boylston: (curve)	93-105	Entering Northbound
		95-98	Leaving Westbound

Noise levels in areas of stations other than platforms will vary with the distance from the tracks, and the shape and composition of openings, passageways, or barriers between the tracks and the area in question. The designers should have measurements made at locations where noise problems are apparent. At locations in the station where personnel are on duty, such as collector's booths adjacent to subway platforms, a health hazard due to excessive noise may be possible. Preliminary study by TSC has indicated that the present facilities lie within present OSHA criteria, but in some cases the margin is small.

Noise levels in bus terminal areas of enclosed stations, such as Fields Corner or Ashmont, may reach 80 to 88 dBA. Generally the bus noise is less of a problem at stations than the train noise.

Exterior noise levels at surface or elevated stations will depend on the location of tracks with respect to the receivers, and the physical design of the structure supporting and/or enclosing the station.

Noise levels adjacent to platforms at open surface stations, such as North Quincy, is similar to levels on the platform, except that the sound will be attenuated with increasing distance from the track. Noise adjacent to station approaches is similar to that on line sections of the same geometric configuration for speeds in the area of 30 to 50 mph (the higher speed being further from the station). At stations with sharply curved track approaches, wheel squeal can be expected, which can cause annoyance to station users or neighbors.

Along subway sections vent shafts occur, often in the vicinity of stations. Depending on their configuration and location with respect to wayside receivers, vent shafts may create problems. Therefore acoustical studies of modernized or new subway stations should include consideration of vent shafts.

B. Noise Criteria for Modernization and New Design

The purpose of these criteria is to establish guidelines for good practice for the designers of new facilities. These

criteria are based on the "Guidelines and Principles for Design of Rapid Transit Facilities" by the Institute for Rapid Transit, draft of June 1972.

Because of the built-in characteristics of existing facilities and equipment, it is not practical to expect that modernized stations and structures will be able to meet these standards. The designer for modernization projects should consider these criteria as a desirable "ideal" goal while in the process of seeking means of making a significant improvement over the existing noise environment.

The IRT guideline criteria are not intended to be, nor are they to be confused with, noise abatement controls of the type enacted or proposed by various communities or public agencies.

1) Types of Noise Criteria

There are two principle types of noise criteria which are based on some measure of human response to noise. They are:

- Criteria Based On Ambient Noise Levels. This type of criterion uses limits based on the difference between the noise in question and the prevailing ambient noise. Criteria based on ambient noise levels are often used to set objectives for remedial design in existing systems. They are generally applicable in problems relating to the system impact on the community.

Ambient noise levels in the community have been rising rapidly in recent years. Criteria based on ambient levels should be reviewed periodically to determine whether or not the ambients will have any significant effect on the public.

Absolute Limit Criteria. These criteria use absolute limits related to measurable physical quantities. They usually deal with hearing damage and protection, speech communication or interference with other tasks and subjective reactions such as annoyance and are used in ensuring an acceptable acoustical environment for passengers and employees of the system.

The use of absolute criteria in design problems relating to system impact on the community should be considered carefully. There is a wide variation in public reaction that can occur even at the same noise levels.

Factors which may affect public reaction to noise, besides the fact that a noise is new and higher than existing ambient level, include high socio-economic status, property ownership, duration and frequency of noise, previous community exposure, nature of the community and its previous success with complaints.

However, the primary objective in good transit design should therefore be to reduce annoyance rather than simply reduce complaints.

2) Rail Transit Noise and Vibration Criteria for New Design

The following assumptions are made in stating the criteria herein:

- Noise, or sound pressure levels, are measured with a sound level meter which meets the Type 2 requirements of American National Standard (ANS) S1.4-1971, Specification for Sound Level Meters.
- All noise levels are in decibels referred to 0.0002 microbar. (0.002 bar)
- The "slow" meter response is assumed for all noise level measurements except those involving measurements of moving and transient sources such as exterior train noise, train noise from vent shafts and car door operation. The latter sources should be measured using "fast" meter response.

RAIL TRANSIT NOISE AND VIBRATION CRITERIA FOR NEW DESIGN

Item	Criteria
a) TRANSIT VEHICLES, NOISE AND VIBRATIONS	
• Vehicle Interior Noise Levels (Empty car)	
In open (ties and ballast) at maximum speed	68 dBA
In open (concrete trackbed) at maximum speed	72 dBA
In tunnels at maximum speed	78 dBA
All auxiliaries operating, car stationary	65 dBA
One auxiliary system operating, car stationary	60 dBA
Door operation	65 dBA
• Vehicle Exterior Noise Levels (50 ft. from T & B Track)	
Car stationary, auxiliaries operating	60 dBA
Two-car train at max. speed (70 mph)	83 dBA
• Vehicle Equipment Noise Levels (15 ft. from car)	
Propulsion system at equivalent to max. speed	90 dBA
Car stationary, auxiliaries operating	65 dBA
Decrease in criteria for presence of pure tones	3 dBA

• Vibration Levels

Measurements taken on car interior surfaces unless noted. Displacements measured peak-to-peak. Velocity and acceleration are:

Item	Criteria
Maximum amplitude	0.10 in.
Maximum acceleration, up to 10 Hz.	0.01 g.
Maximum velocity, 10 Hz. and over	0.03 in/sec.
Maximum amplitude on detached traction motors	0.0015 in.

b) STATION NOISE

- Underground Station Noise Levels

Platform level, trains entering and leaving	80 dBA
Platform level, trains passing through	85 dBA
Platform level, trains stationary	67 dBA
Maximum train room reverbervation time	1.6 to 2 sec.
Platform level, only station ventilation system operating	55 dBA
In station attendants booths	45 dBA

- Surface or Elevated Station Noise Levels (Interior)

Platform level, trains entering and leaving	70-75 dBA

3) Criteria for Community Exposure to Rail Transit Noise and Vibration

The criteria for vehicle exterior noise levels of 85 dBA included in section 2 above represent the maximum noise level permitted at a distance of 50 feet from a train at speed on modern

track. It is necessary, however, that the designer consider the noise and vibration generated by trains, fixed equipment, and by motor vehicles at terminals, as felt by the actual receivers along the wayside.

a) Airborne Noise

Community noise levels may be considered in five general categories according to ambient sound levels at night:

Typical Community Ambient Noise Levels

Area Category	Area Descriptions	Ambient Noise Levels at Night
1	Quiet urban residential, open space park, suburban residential or recreational area. No nearby highways or boulevards.	35-40 dBA
2	Average urban residential, quiet apartments and hotels, open space, suburban residential, or occupied outdoor area near busy streets.	40-45 dBA
3	Busy urban residential, average semi-residential/commercial areas	45-55 dBA
4	Commercial areas with office buildings, retail stores, etc., with daytime occupancy only. Open space parks, suburban areas near highways or high speed boulevards, distant residential buildings.	Over 55 dBA
5	Industrial or Highway Corridors with either residential or commercial areas adjacent.	Over 60 dBA

Airborne noise from above-ground train operations should be considered in relation to the nature of the adjacent community. In view of the transient nature of train operational noise, community acceptance should be expected provided that noise levels do not exceed the following criteria:

NOISE CRITERIA FOR TRAIN OPERATIONS

	Area Category	Transit Noise Level Criteria
1.	Quiet residential	70 dBA
2.	Average residential	75 dBA
3.	Busy residential/semi-commercial	80 dBA
4.	Commercial/open	85 dBA
5.	Industrial and Highway Corridor	85-90 dBA

These criteria are referenced to a point 50 feet from track centre line. In cases where buildings or occupied areas are further from the transit line the criteria may be referenced to the building or area being considered.

It is obvious that to meet these criteria, or more stringent criteria which may be necessary when the right-of-way is close to special uses such as schools, theatres, etc., the designer must provide further means of reducing wayside noise, as will be discussed in the section on noise abatement measures.

Airborne noise from wayside transit facilities such as vent shafts and substations, should meet the below listed criteria. Note that in the case of vent shafts the transient

criteria apply to the sound created by passing trains, and in the case of fan shafts, pumping stations, and substations, the steady state criteria apply. Transient noises are acceptable at higher levels than steady-state noises particularly when the latter contain pure tones.

CRITERIA FOR NOISE FROM WAYSIDE TRANSIT FACILITIES

	Area Category	Noise Level Criteria Transient	Steady-State
1.	Quiet residential	45 dBA	40 dBA
2.	Average residential	50 dBA	45 dBA
3.	Busy residential, semi-commercial	55 dBA	50 dBA
4.	Commercial/open	60 dBA	55 dBA

b) Groundborne Noise and Vibration

Vibration levels from modern transit cars and track are below the threshold of perception in most circumstances. However, these levels are still sufficient to generate a low frequency rumbling noise which can signal the passage of a train. This noise level is frequently of sufficient loudness to create a significant intrusion or annoyance.

The principal noise sources in modern buildings are the air conditioning and ventilating systems and background noises transmitted into the building from street traffic. Noise and vibration from these sources will often exceed those generated by transit operations.

The most critical locations where noise could create intrusion are sleeping rooms and auditoriums. Since sleeping rooms are most common and found in various classes of residences, interior noise criteria relating to these areas should be considered in the same area categories as airborne noise from wayside transit equipment.

For three categories of residential area the background noise in sleeping spaces is generally different, and the allowable noise level can be greater in the noisier areas. The table below indicates the range of levels for transient noise generated by mechanical vibration of the building structures, which should be acceptable to the community if not exceeded. It would be unreasonable in most cases to design for a noise level that is undetectable by occupants. The low level transient noises generated by groundborne vibrations from passing trains must be made unobtrusive but not necessarily undetectable.

NOISE CRITERIA FOR INTERIOR SLEEPING AREAS

Area Category	Building Type And Sleeping Space Description	Groundborne Noise Level Criteria
1. Quiet residential	Private residences	25 to 30 dBA
	Apartments	30 to 35 dBA
2. Average residential	Private residences	30 to 35 dBA
	Apartments	35 to 40 dBA
	Hotels	40 to 45 dBA
3. Busy residential	Private residences	35 to 40 dBA
	Apartments	40 to 45 dBA
	Hotels	40 to 45 dBA

The table below presents generally acceptable noise levels in occupied spaces of various types of buildings. This Table is not intended to be all inclusive but may be a convenient general guide to the designer.

MISCELLANEOUS ROOM NOISE CRITERIA

Type of Building or Room	Groundborne Noise Level Criteria
Auditoriums or Concert Halls	25-30 dBA
Churches and Theaters	30-35 dBA
Music Rooms and TV Studios	30-35 dBA
Hospital Sleeping Rooms	35-40 dBA
Courtrooms	35-40 dBA
Schools	35-40 dBA
University Buildings	35-40 dBA
Offices	40-45 dBA
Commercial Buildings	45-50 dBA

Noise caused by the vibrations which meets the design criteria listed above will not be inaudible in all cases,however, the level will be sufficiently low that no significant intrusion or annoyance should occur. In most cases, there will be noise from street traffic, other occupants of a building, or other sources, which will create intrusion that is greater in level than the noise from transit trains passing by in adjacent tunnels.

C. <u>Suggested Methods for Noise and Vibration Abatement</u>

The designer is expected to explore a number of methods of noise and vibration control. Analysis of the noise problem at particular locations may require a combination of several solutions, some of which may be incorporated in the station or facility construction or modernization project, while others may be made a part of other improvement or maintenance projects carried out by Authority forces or outside contractors. The definition of project responsibility for specific noise abatement measures will be made by the Authority at the conclusion of the preliminary design phase.

The designer should consider the prevailing acoustic environment and the noise and vibration criteria when deciding how improvement can best be attained. In some situations, the retention of an Acoustical Consultant may be necessary. Materials and methods not described herein may be proposed, and will be approved by the Authority provided they meet acceptable standards of safety, durability, maintainability, appearance, and economy.

There are several principal means of abating rail transit noise:

- The most effective way of lessening rail transit noise is in the <u>reduction</u> of sound at its source. This can be achieved through:

(1) Basic design of the cars themselves in order to reduce noise creating movement.

(2) Resilient mounting of track and welding of rails

(3) A continuing program of wheel truing and other car maintenance procedures

- A second method of noise control is isolation, whereby barriers are introduced between the sound source and the receiver.
- A third method is absorption of the sound within a space.
- A fourth method is damping of resonant surfaces.

The first method involves design of cars which is beyond the scope of station and structure designers. The question of track design is covered extensively in the literature and will be only briefly reviewed here. Should noise measurements at particular sites indicate car or track related problems, these should be discussed in the consultant's report. The other methods of noise control will be covered in greater detail as they may be applied by the station or structure designer.

1. Noise and Vibration Reduction at the Source - Track Design

Measures for noise and vibration reduction as applied to track concern rail joints, rail support and rail lubrication.

a) Rail Joints

Rail joints can create noise levels as high as 8 or 10 dB above the normal rolling noise. Welding of joints eliminates this problem though the grinding of the joint must be carefully done to be an effective noise reduction measure.

On lines with older signal systems insulated joints are necessary (Green, Orange and Blue lines) at the ends of track circuits. Normally these occur near the ends of stations. Lines with modern cab signal systems such as the Red Line do not require insulated joints except at interlockings.

"Frozen joints" created by glued or Huck bolted joint bars with no space left between rail ends do not substantially reduce noise compared with a normal bolted joint.

b) Rail Support

The conventional form of track construction on MBTA lines consists of rail resting on tie plates and secured to wooden ties with cut or screw spikes. In some cases thin pads are placed under the tie plate to reduce tie wear. Surface track on the South Shore Line has the rails attached to concrete ties with spring clips, with an elastomeric pad between rail and tie for vibration and electrical isolation.

Conventional construction has the disadvantage of producing rattles or impact sounds when the rail is not tightly fastened to the tie. On the other hand, the wood ties have some capacity to attenuate vibration, compared with concrete ties.

At bridges on the South Shore Line, the rails are clamped directly to the concrete deck with rubber pads between rail and deck and between rail and the hold-down clamps. Because of the configuration of the fastener and resonance of the bridge deck and supporting beams, the noise level on these bridges is up to 12 dB higher than on concrete tie and ballast surface track.

The design of earlier generation of track fasteners such as used on the South Shore bridges and on other systems, requires that the under-rail pad be preloaded by the bolts which clamp down the rail.. Thus a portion of the resiliency of the pad is lost. More recent fasteners such as the "Landis Fasteners" used on BART permit the rail to float by clamping the rail to a steel plate forming the top layer of a rubber sandwich. The steel plate at the bottom of the sandwich is then attached to the bridge deck. This system on BART results in noise levels on bridges only ≠4 dB higher than tie and ballast surface track.

In MBTA subways wood tie and ballast construction is normal, however the ballast below the ties is only 6 to 8" deep, and is fouled with years accummulation of subway dirt. This reduces the

effectiveness of ballast as a vibration isolator. At specific locations it may be necessary to support the rail on the ties with resilient fasteners to achieve a significant reduction in structure borne noise and vibration.

A new method of rail support in subways now being installed in certain sections of the Washington Metro is the "floating slab". It consists of a continuous reinforced concrete slab mounted on resilient pads free of the tunnel invert and walls. The rails are held in place by resilient fasteners such as those used on BART. Preliminary tests indicate a 10 to 15 dB reduction in vibration intensity in the lower middle frequency band. Metro will use this system where the subway passes under or close to noise or vibration sensitive structures.

c) Rail Lubrication

Wheel-squeal at shart curves can be reduced in intensity and duration or even eliminated by use of lubricating devices. Grease type lubricators apply to one or both faces of the wheel flanges as they approach a curve. The wheel carries the lubricant along the curve, depositing it along the edge of the running and restraining rails. A problem with these devices is that excessive amounts of lubricant can accummulate on the running surface of the rail, interfering with normal braking of trains.

Another type of lubricator sprays water, or water with a small amount of lubricant in suspension, on the wheel and rail at the start of a curve. Trial of this method on the MBTA indicated that the water dried off at about the end of the curve so that interference with normal braking was minimal. This method cannot be used on outdoor locations during the winter months.

2. <u>Noise Reduction by Isolation</u>

The placement of barriers between the noise source and the receiver are a very effective means of reducing noise.

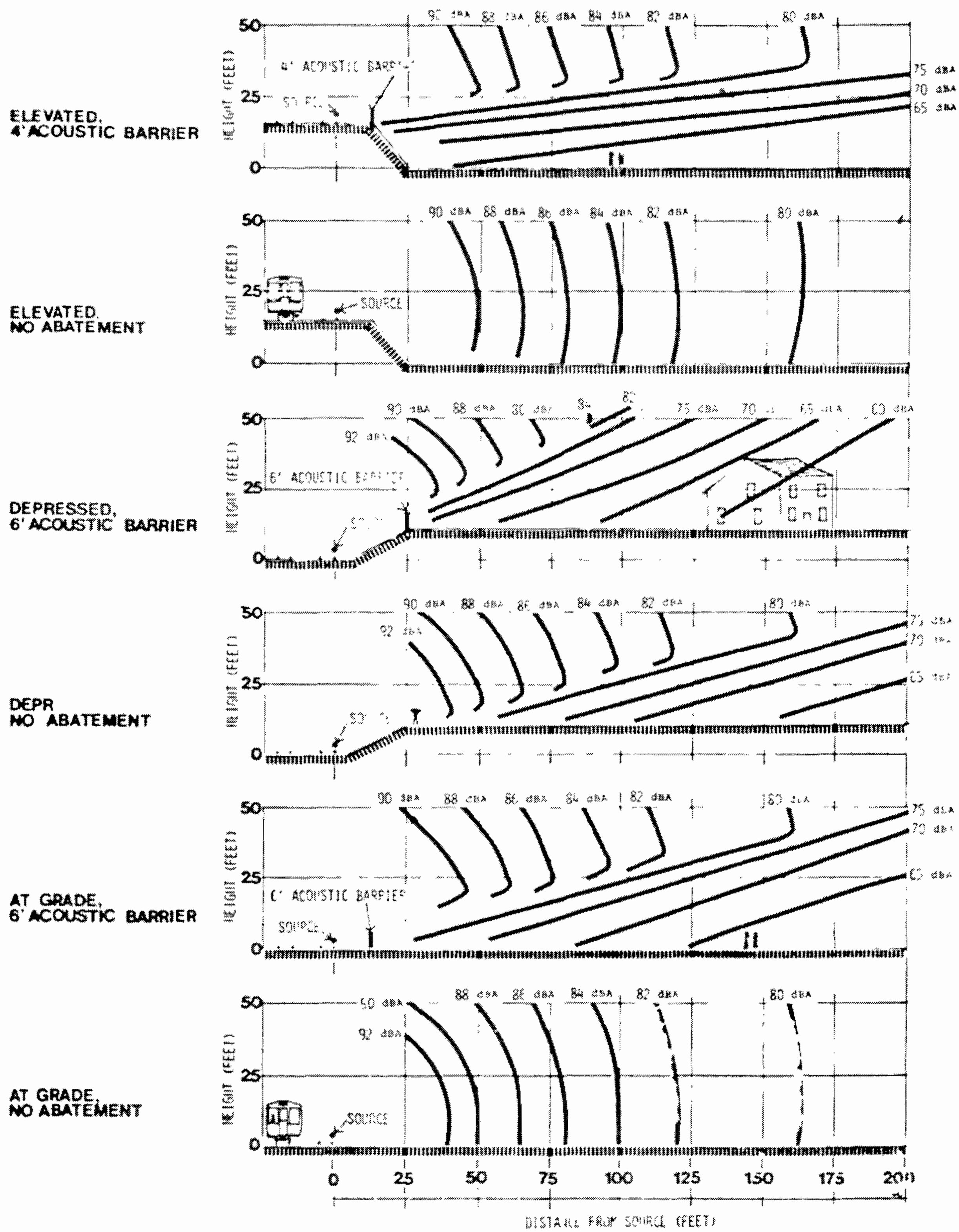
a) <u>Wayside Barriers</u>

Barriers along surface rail lines or solid-deck viaducts can reduce noise levels from 6 to 12 dBA. Maximum effectiveness can be gained by eliminating openings which would allow sound to bypass the barrier, and by placing sound absorbing material on the face of the barrier. The barrier should be close to the source, and extend to car floor level.

Barriers may be constructed of concrete, masonry, earth, or light weight wood or metal panels. Normally mass is required to stop transmission of sound but in the case of the light-weight panels, the sound absorbing material against a solid backing can trap some of the sound on its way through. As barriers will reflect sound it may be necessary to apply sound absorbing material to wall surfaces across the track from a barrier.

(Sound absorption treatment is discussed in detail in part 3 of this section.)

A very effective barrier results from depressing track in an open cut with walls or slopes. Depending upon the location of the receivers, barrier walls at the top of slope may be required. Figure 5 shows noise reductions expected by various wayside barriers.



PEAK NOISE CONTOURS

b) Barriers in Stations

At certain stations it may be possible to utilize noise barriers. At Park Street and Boylston Stations, where some of the most acute problems occur there are opportunities for this treatment. Stations with staggered platforms expose persons on one platform to noise from trains at speed on the track in the opposite direction. Because of the nature of an enclosed station where sound is reflected by walls and ceilings, etc., and thus reaches the receiver by many paths, barrier design in the subway requires more analysis than that required by a wayside installation. This is discussed in the following paragraphs taken from Bolt Beranek & Newman Inc. Report 2052 made for the MBTA in 1970:

The effectiveness of acoustic barriers depends on whether the listener is in the direct or reverberant sound field. The direct sound field is close to the sound source where the SPL owing to sound transmitted directly from the source to the listener is greater than the SPL owing to multiple reflections of sound. Conversely, the reverberant field describes the region farther from the source where reflected sound waves dominate. For the stations we studied, the reverberant field begins approximately 10 ft. from the train wheels.

Barriers reduce direct-field noise levels by "shielding" the listener from the sound waves. The sound which the listener actually hears is diffracted or "bent" over the top of the barrier. However, sound will also be transmitted through barriers and may be significant if the barriers are too flimsy. For the reverberant field, the barrier is effective only in absorbing a portion of the sound power radiated by the source. For example, a barrier must absorb 90% of the sound power to reduce the reverberant field by 10 dB. Thus, to reduce reverberant field levels significantly, barriers, along with acoustical treatment along other paths from the source, must cover a substantial portion of the area through which sound can be radiated.

The BB&N study considered the possibility of using barriers in low platform stations such as Government Center, where gaps would be left to provide access to the trains. It was found however, that the intermittent sound level produced by train wheels passing the barrier gaps would be more annoying to the receiver than the situation with no barrier at all.

Barriers should be placed as close to the source as possible. On curves there must be sufficient space allowed for overhang of the car ends outside of curves, and car center inside of curves, plus an allowance for car roll. Safety niches for personnel must also be provided approximately 20' on center if refuge space is not available immediately across the track from the barrier.

To be effective in reducing reverberant field levels, absorptive barriers must be used on both sides of the vehicle; or if there is a wall next to one side, it should be treated with an absorptive material. It is essential to line the barrier with an absorptive material in order to dissipate acoustic energy. The thickness of the material should be equal to approximately 1/4 of the wavelength of sound to be attenuated.

The sound power radiated beyond the barrier will be approximately proportional to the ratio of the angle subtended by the gap between the barrier and car to the total angle (approximately 90°) from which the sound is radiated to one side of the car. Thus the noise reduction is given by

(1)

$$\Delta L = 10 \log \left[\frac{\pi/2}{\tan^{-1}(a/h)} \right]$$

where h is the barrier height. From Eq. (1) we find that a 10-dB reverberant-field reduction requires that $h \geq 7a$.

Barriers attenuate radiation to the direct field principally by diffraction rather than absorption. The excess attenuation A_e along a line perpendicular to the top edge of the barrier is given approximately by

(2)

$$A_e \cong 10 \log \frac{fh^2}{ca} + 10$$

where h is the barrier height, f the frequency, and c the speed of sound in air. Equation 2 is valid for values of A_e up to approximately 20 dB. Values in excess of the 20 dB predicted by Eq. 2 should be reduced to 20 dB. Furthermore, Eq. 2 is based on the assumption that the sound source is at the same height as the base of the barrier. This is not entirely valid since sound is probably radiated from the entire wheel surface. Hence, Eq. 2 is an upper bound to the direct-field noise reduction provided by a barrier.

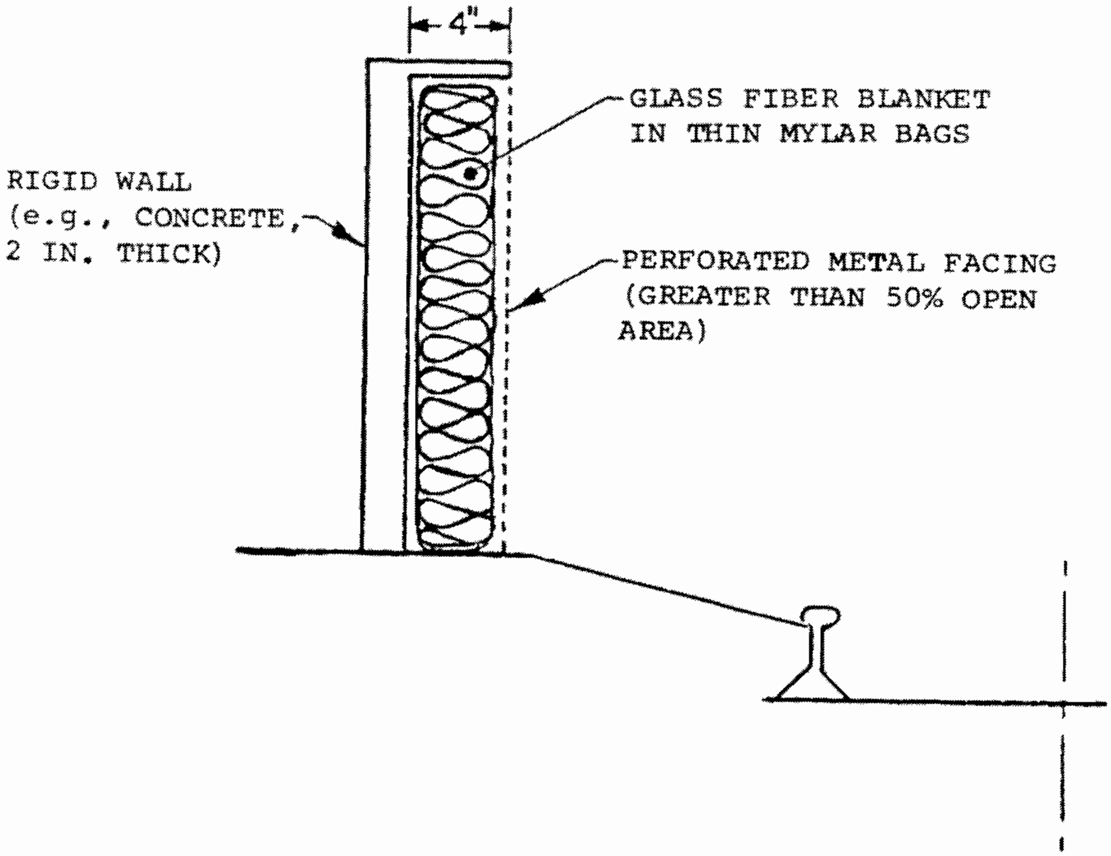
The direct-field and reverberant-field reductions in sound pressure level are shown in the Figure 6 for three stations of interest. We find that the maximum values of direct-field attenuation vary between approximately 15 and 20 dB. In the reverberant field (farther from the train) the noise reduction is less, ranging from an estimated 4.2 to 10 dB. The comment "with full wall lining" applies to those sections of the track that are bounded by a full height wall. The desired sound reduction requires that these walls be lined with an absorptive treatment like the barrier treatment shown in Figure 7 .

Barriers should generally be constructed as illustrated in Figure 7 . The essential features are a rigid wall lined with a sound-absorbing material which faces the noise-producing wheels. The construction details are unimportant, provided they meet the following criteria:

BARRIER EFFECTIVENESS AT THREE MBTA STATIONS.

Location	Track Radius (ft)	Barrier Clearance at Truck Center: Inner A_{ib}	Barrier Clearance at Truck Center: Outer A_{ob}	Direct Field maximum value of A_e at 10 ft for 3-ft barrier: 800 Hz	2850 Hz	5700 Hz	Reverberant Field	Comments
Park Street	45	2.1	2.0	15	20	20	4.2	
	82	1.4		16	20	20	8.0	with full wall lining
	100	1.2	1.2	17	20	20	6.1	
Government Center	100	1.2		17	20	20	9.0	with full wall lining
	180		0.9	18	20	20	10.0	with full wall lining
Boylston Street	85	1.4	1.4	16	20	20	5.6	*
	89	1.3	1.3	16	20	20	5.6	

*A full height wall between the curved portions of the tracks extending into the station approximately 50 - 100 ft beyond the curves would be very effective in reducing noise levels owing to outbound trains. The lower 3 ft of the wall should be lined with absorptive material similar to that used in barrier construction, not only to reduce station noise but also to reduce sound reflected back toward the cars.



SCHEMATIC DIAGRAM OF BARRIER CONSTRUCTION

1) The wall should be sufficiently massive to attenuate the sound passing through it by a greater amount than the attenuation of sound passing over the top. For example, a 2 - 4 in. concrete wall would be adequate.

2) The absorptive coefficient of the material should be greater than 0.8 over the frequency range of interest (800 - 5000 Hz) This can be accomplished with a 4-in. thick Fiberglas blanket.

3) The porous material must not be allowed to become clogged with dirt. Enclosing the blanket with very thin Mylar bags is probably the best current procedure.

4) The absorptive layer should be protected from damage. This can be done by covering it with perforated sheet-metal with an open area of 50% or more.

3. <u>Noise Reduction by Absorption</u>

a) <u>Station Treatment</u>

As seen in the discussion of barriers, it is necessary to utilize sound absorbing materials on barriers, and in subways on walls associated with barriers. Additional improvement in the noise level at stations can be achieved by treating ceilings and walls with sound absorbing material.

In typical interior architectural spaces where the length, width, and height of the space do not vary from each other by a factor of more than two or three to one, the sound level drops off as one moves away from the source until the "reverberant field" of the room is reached. From this point, increasing the distance from the sources does not result in a further decrease in the sound level. The addition of sound-absorbing treatment in such a space will result in a reduction of the sound level in the reverberant field of the room, although it will have no affect on the sound level in the near field of the source. If the original room consists of hard, sound-reflecting surfaces (e.g., concrete), the addition of substantial amounts of sound-absorbing treatment can result in reductions in the reverberant sound level of as much as 15 decibels.

Acoustically, subway stations represent a type of space much different from the normal interior architectural space described in the paragraph above. This station may be considered as a "two-dimensional room". The width of the station is from four to ten times the height, and the length of the station is approximately 20 times the height. In this type of space, the sound level drops as one moves away from the source of sound much as it does in the near field of the sound source in a normal "diffuse" room. Instead of leveling off, as it does when one

reaches the reverberant field in a normal diffuse room, the level continues to drop with distance so that the farther one moves from the sound source, the lower the sound level will be. In its present condition, with all surfaces hard and sound-reflecting, the following reductions in sound level may be expected as one moves away from a sound source:

Table I
SOUND LEVEL REDUCTION WITH DISTANCE FROM THE SOURCE

Change in Distance From Source	Reduction in Sound Level (dB)
3 ft - 6 ft	5
6 ft - 12 ft	4
12 ft - 24 ft	3
Beyond 24 ft	3 dB per doubling of distance

Reductions in sound level shown in the table above may be added together to find the total drop-off. For example, if one moves from 3 ft to 24 ft from the sound source, the total sound reduction will be the sum of 5 + 4 + 3, or 12 dB. The table is somewhat simplified and ignores the wall reflections which would influence the results, particularly for locations close to wall surfaces. It is not felt, however, that these differences would have any significant affect on final conclusions relating to sound-absorbing treatment within the station.

The sound field within the station can be influenced by the addition of a highly efficient absorbing treatment to the entire ceiling of the station. For example, suspended perforated metal pans with glass fiber batts above or a porous, washable ceramic acoustic tile would be desirable. This type of treatment would result in greater attenuation of sound as one moves away from the sound source. The following conditions might be expected if the entire ceiling in the station consisted of a very efficient sound-absorbing material.

Table II
REDUCTION OF SOUND WITH DISTANCE IN A STATION
WITH A SOUND-ABSORBING CEILING

Change in Distance From Source	Reduction in Sound Level (dB)
3 ft - 6 ft	5
6 ft - 12 ft	5
Beyond 12 ft	5 dB per doubling of distance

Using the information presented in Tables I and II, the noise reduction due to addition of a sound-absorbing ceiling may be calculated as a function of distance from the sound source. The following table presents this information.

Table III

NOISE REDUCTION DUE TO CEILING TREATMENT IN PARK STREET STATION

Distance from Source	Noise Reduction (dB)
6 ft	0
12 ft	1
24 ft	3
50 ft	5
100 ft	7
200 ft	9
400 ft	11

Preliminary study of Park St. Station by BB&N indicated that significant reductions in noise level of 7 to 11 dB were possible over much of the station. In certain frequency ranges where wheel-squeal peaks occur, reductions as high as 15 dB are possible. As stations such as Government Center, where curve tracks run through the station, little reduction immediately adjacent to the track is possible, but at locations further from the track would get 5 to 10 dB reductions.

The result of extensive sound absorbing treatment in subway stations would be greater than a simple reduction in overall noise levels. The effect of sound-absorbing treatment in any noisy environment is usually to make the space "feel" quieter than it actually is by minimizing the persistence (reverberation) of sound in the space and making the sound seem to come from its

actual source and not from everywhere. Ideally, efficient sound-absorbing treatment should be applied to the enclosing surfaces of a given station to the maximum possible extent. For practical reasons, considering durability, ease of maintenance, etc., the areas available for sound-absorbing treatment are limited to the ceiling surfaces and, in some cases, the lower wall areas adjacent to the tracks (i.e., side pit areas). The reduction in reverberant noise levels in a typical station may be approximated by the relationship:

$$NR = 10 \log 10 \frac{S_2}{S_1} \tag{3}$$

where: NR is the noise reduction in decibels

S_2 is the calculated total absorption in sabins after treatment (sq. ft. of absorbing area x its sound absorbing coefficient)

S_1 is the calculated absorption in sabins without treatment

The following factors should be observed in the selection and use of sound-absorbing materials to reduce noise levels:

- Sound-absorbing materials should be located insofar as possible to avoid large areas of opposing hard, sound-reflective surfaces.

- Sound-absorbing efficiency of materials generally increases with increasing thickness. Materials spaced away or suspended from a hard backup surface (i.e., Mounting #7 as defined by the Acoustical Materials Association) will provide increased low frequency absorption over the same material applied directly to a hard backup surface (Mounting #1)
- Materials placed in strips, or patches (2-4 ft wide) with hard areas between often provide as much absorption as continuous areas of the materials due to diffraction and edge effects.
- Materials with relatively large fissures or perforations on the surface are least effected by future painting from the standpoint of sound-absorbing efficiency.
- Treatments using glass fibre baths should have the bath contained in Mylar bags to prevent clogging of pores by dirt.
- Care should be taken to avoid build-up of dirt on top of suspended ceiling panels. Such panels should also be designed to prevent their being blown out by air currents or over-pressures caused by passing trains.
- Materials should not create a fire hazard.

- Absorbent materials not enclosed by bags, such as spray-on types, should be washable.
- Materials should be selected which are colored, or can be painted to minimize discoloration by dirt near the track bed, and minimize loss of light when used at or near the ceiling.
- Easily damaged materials should not be used on surfaces where they may be reached by the public to eliminate vandalism.

Recommended specifications to cover sound absorption for sound absorbing materials suitable for ceiling and wall applications are as follows:

The sound absorption performance for the materials shall be verified by a test report from an independent acoustical laboratory. The test shall be conducted in accordance with Recommended Method of Test ASTM C-423-60T.

- For suspended sound-absorbing materials the sound absorption coefficients shall meet or exceed the following values:

Frequency, cps	125	250	500	1000	2000	4000
Absorption coefficient	0.2	0.4	0.7	0.8	0.8	0.8

- For surface-applied materials the sound absorption coefficients shall meet or exceed the following values:

Frequency, cps	125	250	500	1000	2000	4000
Absorption coefficient	0.2	0.4	0.7	0.8	0.8	0.8

b) <u>Tunnel Treatment</u>

The tunnel areas outside of stations may be treated with sound absorbing materials. In this case appearance of the material and susceptibility to vandalism is not a problem. However certain materials, such as glass fibre bats in plastic bags, would have to be protected by a durable mesh or screen to prevent accidental damage by workers in the tunnels.

The material is normally applied to the lower 5' or 6' of the tunnel walls. This treatment can result in noise reduction in the vicinity of 5 dB.

4. <u>Damping of Resonant Surfaces</u>

Secondary radiation from structural members of viaducts, or wall or ceiling surfaces in stations can add to the noise level created by passing trains. Some of these problems can be avoided by initial choice of material. For instance, a precast concrete bridge structure will be less resonant than a similar structure in steel.

Application of a viscoelastic material to surfaces of beams or panels works by reducing the height of resonance peaks. Thus this treatment can reduce identifiable tones making the sound more acceptable. The material is effective on large uninterrupted radiating surfaces, such as thin plate girders, but would be useless on small members of a steel truss.

The materials should be very stiff, nearly that of the surface they are being applied to. They may be applied as a single layer, or as a sandwich, with the viscoelastic material being covered by a metal constraining sheet.

5. Other Methods of Noise and Vibration Abatement

It may be necessary to treat the building or structure on the receiving-end of rail transit generated noise, rather than, or in addition to, treatment of the transit facility. In the case of structure or ground borne noise or vibration, a building or space within a building may be floated on resilient pads to isolate it from such disturbances. This could apply particularly to air rights buildings.

Experience in London has shown that elastomeric pads can be considerably more effective than the traditional lead-asbestos pads used in the U.S. They were used in new structures immediately over transit tracks in open cut, and in buildings near deep "tube" lines lying in London Blue Clay which was a good transmitter of vibration at certain frequencies.

Airborne noise may be reduced at the receiver by use of double glazing. This may require installation of air conditioning which has the additional effect of raising the ambient noise level and making the intermittent train sounds less noticeable.

In extreme cases, it may be more cost effective to acquire properties suffering from an acute transit noise problem, rather than the noise generator or receiver.

1. System Requirements

Unless determined otherwise by the Director, every station shall have a paging and announcing system for the dissemination of schedule changes, arrival and departure calls, and emergency announcements. The system need not attempt to overpower the noise of trains, but must provide intelligible information for auditors at platform level, when trains are not in motion. In the highly reverberant environment of station, this will mean a relatively large number of low power speakers fairly closely spaced.

Microphone positions are required in all collection and token booths, and in all starters rooms. Each position will have a monitor loudspeaker. Amplifier equipment should be located in a central equipment room, preferably an electric or other room which will not normally be accessible to unqualified personnel. Equipment confined to a small space must be adequately ventilated. In every station there should be a conduit running to the tunnel electric duct bank to permit future connection to a more general system.

2. Consultant's Report

One matter that has been discussed, is the possibility of installing loudspeaker systems in the stations to transmit announcements and, if desired, playing backgroud music. Such a system can only be satisfactory in a station that has been treated with sound-absorbing material to make it reasonably "non-reverberant." Our preliminary studies indicate that it is unrealistic to attempt to design a loudspeaker installation that would override the noise of subway trains entering the station, but there is no reason why the system cannot override the average rush hour condition when trains are not actually moving.

The following performance objective should be considered in the design of a system to be used in the subway stations. The loudspeaker system should provide:

a) Satisfactory levels of amplified sound, with respect to ambient noise levels expected during both quiet and peak activity periods. The system would not be expected to override excessive levels during an actual train passage.

b) Frequency band width of reproduced signals with minimum reverberation and echo effects caused by sound reflection from the station boundaries.

c) Simplicity of system operation and control.

Our preliminary studies indicate that the only type of sound system that makes sense in a subway station is the type generally used in the better airport terminals; a distribution system of loudspeakers located in the ceiling. Each loudspeaker covers only a limited floor area and sends sound down on top of the "audience." It does not spray energy all over the walls and other distant surfaces. The loudspeakers would be spaced to give uniform coverage and in most cases, would have an on center spacing approximately equal to the ceiling height. Only by a carefully controlled, continuous distribution of sound can we hope to achieve fairly uniform levels throughout the station, at the same time giving high quality reproduction of announcements and music.

In general, the sound system design must be considered as a part of the overall design of the acoustical environment; not as a separate element to be designed independently. The poor results observed in the numerous transportation terminals around the country attest to the folly of this course. We urge that sound system design be included as part of the total architectural modification program of existing stations as well as in the design of new ones for the MBTA.

Bolt, Beranek and Newman, Inc.
Draft Report 30 June 1965

3. System Specification

The Sound System should be consistent with SPECIFICATIONS FOR LOCALLY AND REMOTELY CONTROLLED PUBLIC ADDRESS SYSTEMS FOR PASSENGER STATIONS METROPOLITAN BOSTON AREA - MASSACHUSETTS MBTA CONTRACT NO. SM-500 (R) OCTOBER, 1972

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A RD 105 Investigation of Noise and Vibration in Buildings adjacent to the Bloor-Danford Subway, 17 pages with charts.

B RD 106 Track Fastenings, 16 pages with charts and illustrations.

C RD 107 Noise and Vibration Theories, 32 pages with illustrations and charts.

D RD 108 Rapid Transit Systems, 24 pages, charts and illustrations.

E RD 109 Noise and Vibration Control, 13 pages of text only.

F RD 110 Summary consisting of 14 pages and Bibliography.

12. NOISE LEVEL MEASUREMENTS ON THE UMTA MARK I DIAGNOSTIC CAR (R42 MODEL) Rickley, E. J., Quinn, R., Byrnon, G., Transportation Systems Center, Cambridge, Mass., October 1971, Technical Report, 9 pages of text, Summary, 11 appendices, illustrations and tables.

13. SAN FRANCISCO BAY AREA TRANSIT DISTRICT-DEMONSTRATION PROJECT Technical Report Number 8 - Acoustic Studies, June 1968, 157 pages of text, 10 sections, illustrations, Appendix and Reference Documents.

14. STUDY OF THE MAGNITUDE OF TRANSPORTATION NOISE GENERATION AND POTENTIAL ABATEMENT, Serendipity, Inc., Prepared for the Department of Transportation, November 1970 - Seven volume study of the development of a long range program for the assessment of transportation noise abatement problems and their potential solutions.

15. TRANSPORTATION NOISE BULLETIN - Abstracts of Reports and Resumes of Research Projects Dealing with Transportation Noise, Highway Research Board, Vol. 1, #1, October 1971, Vol. L, #2, April 1972.

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MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

GUIDELINES AND STANDARDS
PART IX
SERVICE FACILITIES
REVISED 1977

MANUAL OF GUIDELINES AND STANDARDS

GENERAL INTRODUCTION

The Massachusetts Bay Transportation Authority has found it both necessary and possible to concentrate attention on the complex needs of people. Programs to improve service must now include a new emphasis on the quality of the transportation experience. In effect, transportation engineering has been joined by human engineering and environmental design.

This manual provides a framework for the continued coordination of all those elements in the system that affect human comfort.

Many of the criteria involved are common to all environments, such as the control of light, noise, humidity, temperature, wind, and odors, or the need for orderliness, through clear and easy circulation and clean appearance. Other criteria that are more specific to the transportation environment are such needs as safety, traffic handling capability, spatial variety, consistently available information, and orientation.

The most important single criterion that has guided the preparation of this manual is the need for orientation. The rider must not only be physically comfortable, he must also know in the fullest sense where he is and where he is going.

Since to the layman a public transportation system is to a large extent an invisible skeleton of the city and metropolitan region, the comprehension of that structure generates an awareness and appreciation of the city itself, and an appreciation of travel through it.

There are many aspects to achieving this orientation. Circulation at all points must be direct and open. Spaces should relate visually to their surrounding environment, either through direct openings to adjacent spaces and structures, or in the case of platforms, by graphic reflection through photographic murals.

Above all, the need for orientation places great emphasis on maps and a consistent system of identification and directional signing. Graphics then emerges as a major factor in the design of each environment, a factor that must be given high priority in the early design phases of each project.

It is hoped that all participants in all programs will familiarize themselves with the entire manual, so that the implications of each decision can be understood in a system-wide context.

The standards and guidelines presented here are not inflexible rules. They are a framework for meaningful development and variety, and offer no restriction to the capacity of each participant to evolve better solutions to old or new problems.

As new solutions are developed and approved, revised and additional pages for the manual will be issued to all participants.

Part IX of the Manual describes the functional requirements for the non-public work areas of the station, and the design requirements and treatment of the public toilets. It further sets down existing and proposed Authority policy with regard to station drainage, water supply and fire protection, heating, ventilation, communication systems, and electrical systems.

Refer to Part VI: Lighting for lighting standards, to Part VIII: Acoustics for the sound system, and to Part XI-C for heating and ventilating requirements.

PART IX SERVICE FACILITIES

1. General

Separate toilet facilities will be provided for the public and the staff. The public facilities must be accessible and useable by the physically handicapped.

Public toilets are located in the primary station lobby, preferably in the paid area, with doors within direct view of the collector's booth.

Staff toilets are located in each lobby, and at major bus terminals (where buses layover) adjacent to the busway. They are also provided at platform or track level at rail terminals, usually in conjunction with road and yard crew lobbies, and at traction power substations.

Mens and womens facilities are provided in all cases, except in traction power substations where a single room is sufficient

2. Number of Fixtures

Type of Facility	Water-closet	Urinal	Lavatory	Handicapped Requirement
Public Men's	1	1	1	yes
Public Women's	2		1	yes
Staff Men's-Sta. Lobby	1		1	no
Staff Women's-Sta. Lobby	1		1	no
Staff Men's-Bus Terminals	1	1	1	no
Staff Women's-Bus Terminals	1		1	no

Staff toilets at rail terminals will be slightly larger than at bus terminals, depending on number of personnel assigned to the location.

DESIGN STANDARDS

3. Finishes and Equipment

Finishes and equipment shall generally be the most rugged, impervious, easily cleaned and chemically resistant obtainable, consistent with reasonable standards of economy and appearance. Where new floor surfacing is installed, a waterproof membrane shall be included.

Doors shall have either a louver, or be undercut. They shall have automatic closers, pushplates and kickplates, and a deadlock only.

Toilet partitions, with stainless steel doors, and urinal screens should be provided, constructed of glazed masonry, glazed tile, or stainless steel, well supported against lateral force. Porcelain enamel is insufficiently resistent to marking for use in toilet partitions.

Each toilet room shall have a plate glass, stainless steel-framed mirror, sized to fit the available opening, and preferably located away from the lavatory. Each women's toilet shall have a stainless steel shelf, mounted below the mirror at 3'-4" height above the floor.

Each toilet room shall have an electric hand dryer, recessed wall mounted type, (World Dryer Co., Model RA, or approved equal), with the nozzle fixed downward.

Soap is not provided. Toilet paper is supplied by the Authority, who will install the toilet paper holder.

4. Plumbing

Plumbing for new and modernized toilets shall be in accordance with the Boston Plumbing Code.

Each new toilet room, and, if possible, each modernized toilet room, shall have a floor drain. Supply valves shall be concealed from public access. Valves and clean-outs must be easily reached either from service areas behind the wall, or through vandal proof access panels from the toilet rooms themselves.

Acceptable fixtures shall be equal to the following. As no hot water will be provided, the lavatory shall have the hot water faucet opening blanked off. Substantial wall carriers should be provided for all fixtures.

water closet	American Standard Instanto F-2515
urinal	American Standard Washbrook F-6505
lavatory	American Standard Prismere F-5515-1

5. Ventilation - See Part. XI-C

6. Lighting

Toilets will typically be lighted by a wall mounted fixture extending from wall to wall over the plumbing fixtures. Other lighting should be provided as required, with the intent that every part of the room be highly illuminated. Emergency lighting is required.

7. Heating - See Part. XI-C

1. General:

Every fare collection layout requires the use of two safes, one for cash deposits by the collectors, and one for the temporary storage of fare boxes. The former safe is always located in the primary collection booth; presently the latter safe is sometimes left freestanding close to the fare collection equipment and sometimes put in a safe room. The Authority intends that all new and modernized stations have safe rooms.

2. Collection Procedure:

(1) A special crew visits each station early in the morning, and leaves with the first collector of packet of change, and if used, sufficient tokens for the day.

(2) There are several shifts of collectors. As each leaves his post he turns over to his relief only the amount of change which he was originally given, sealing the excess cash in a bag and depositing it, with a report form, in the collection booth safe. The last collector bags and seals all the cash, and deposits them in the safe.

(3) At closing time, and as may be necessary during the day, the starter removes loaded fare boxes from the turnstiles and locks them in the safe room safe. He finds the safe unlocked, and having shut the boxes within the safe, cannot again unlock it. Therefore another safe must be used for each successive change of fare boxes.

(4) The special crew in the morning brings empty fare boxes, as well as new change. It collects the loaded fare boxes from the safe room safe, and the cash from the collection booth safe and returns them to the central accounting office.

3. Size of Safe Room:

A desirable minimum safe room size is 75 square feet, proportioned to permit 90° swing of the safe door; however, existing conditions may dictate less. In any case the Authority will establish the number and sizes of safes to be accommodated. The Authority uses a number of different sizes of safes. The number of safes required is equal to the number of times the fareboxes are changed during the day. Safe room safes are primarily for storage of tokens; however in some cases they also are used for cash and will require an ADT connection. The safe room should also accommodate at least one change of fare boxes, which can be placed atop the safe. Fare boxes are 9" x 9" x 18" high.

4. Location of Safe Room:

Safe rooms should be located as close to the fare collection equipment as possible, and should not open into collection booths. They should open onto the paid area. Doors should have a lock, and must be sized to permit entrance of the safe. The Authority will provide cylinders for the safe room door locks. Some means of ventilation should be provided, by undercutting the door, or, if a louvre is used, it should be barred on the inside. Both normal and emergency lighting should be provided. See Part XI-C for heating and ventilating requirements.

1. Starter/Inspectors Room at Way Stations:

The starter or inspector is normally assigned to supervise more than one station. He uses the starters room only to fill out reports and make telephone calls. Ideally each station should have a starters room at platform level, centrally located, on each platform. Failing this, surface car stations can make do with a room on one platform and provision for cross-over between platforms. If there is a crossover at the station, the starters room should be located at the end of the platform adjacent to the crossover.

The room need only be large enough to accomodate one man, at a stand up çounter, or approximately 25 sq.ft. Equipment includes the stand up counter, a microphone jack and monitor loudspeaker for the paging and announcing system, and a telephone connected to the central MBTA switchboard. The door should have a lock, and either an undercut or a louver. In small starters rooms, used for no other purpose, the door should have a glass view panel. Both normal and emergency lighting should be provided. In special cases, other station control equipment, such as alarms and switches, can be located in the starters room. See Part XI-C for heating and ventilating requirements.

2. Inspectors Room at Terminal Stations:

This facility may be occupied full time, serving as an office for direction of train and yard personnel assigned to the terminal. It should have an area of 100-150 sq.ft. Equipment is similar to that of the starters/inspectors room at way stations. Windows overlooking the platform or track area should be provided. The room is normally located adjacent to the train crew lobby at the end of the station platform closest to the train storage or turnback tracks. See Part XI-C for heating and ventilating requirements.

<u>DESIGN STANDARDS</u>

3. Bus Starters Room:

This facility may be occupied full time, or during rush hours, and serves as a control center for bus operations at stations where bus routes terminate. It should have an area of 50-100 sq.ft. Equipment is similar to that of the starters room at way stations. Windows overlooking the busway and bus passenger waiting areas should be provided. The starters room should be located near the center of the busway, and if possible, adjacent to the train station lobby or entry so that the starter can provide assistance to waiting bus patrons, as well as overseeing the operation of the buses. The bus drivers toilet rooms may be located adjacent to the bus starters room, but should not be entered via the starters room. See Part XI-C for heating and ventilating requirements.

DESIGN STANDARDS

1. A porters room should be provided on each train platform and fare collection lobby. In stations with extensive covered busways or lengthy enclosed passageways or concourses, additional porters rooms may be required.

2. Porters rooms are 75 to 100 square feet in area. They should have a service sink, hot and cold water, a floor drain, shelving for janitors supplies, and racks for hanging mops and brooms. Space for storage of a floor cleaning machine (approx. 2'x3') and for storage of filled trash bags is required. Wall and floor finishes should be resistant to water and strong cleansers. The door should have a lock and either an undercut or a louver. Only normal lighting need be provided. See Part XI-C for heating and ventilating requirements.

DESIGN STANDARDS

1. Electrical rooms should be provided where required to contain station electrical equipment, such as AC and DC panels, switchgear, and entrance equipment. These rooms should be sized and located by the station electrical designer and architect. A lamp storage room, see Part IX F1, may be adjacent to an electrical room.

2. Electrical rooms vary considerable in size. The smallest is a panel room of 50 sq. ft. and the largest is a station unit substation with a maximum area of 2000 sq. ft. The larger facilities are provided at stations having a large lighting or power load such as a major parking facility, or many escalators, ventilation fans etc.

3. Extreme care must be taken that seepage of water does not occur into electrical rooms. Doors should have locks and be sized to accomodate the passage of equipment. All doors should have louvers. All electrical rooms must have both normal and emergency lighting. See Part XI-C for heating and ventilating requirements.

DESIGN STANDARDS

1. A lamp storage room should be provided in each station, preferably adjacent to the main electrical room in the station. It should not be entered via the electrical room.

2. This room should have an area of approximately 100 sq. ft. It should have shelving and racks to accomidate the various sizes and types of lamps used in the station, as well as a step ladder. It must have both normal and emergency lighting. See Part XI-C for heating and ventilating requirements.

DESIGN STANDARDS

1. A signal equipment room should be provided at each station. It is located at track or platform level near the end of the platform. Usually it is outside of the platform area, though it may be located within the platform area if necessary. If there is an interlocking (crossover or junction) near the station the signal equipment room should be located at the end of the station closest to the interlocking. Conduit and ducts will lead the signal and related cables from the room to the right of way.

2. A signal equipment room at a way station is typically 300 sq. ft. (min. of 10' x 30'), and at an interlocking 500 sq.ft. (min. of 10' x 50'). The precise size is determined by the signal designer. At subway stations it is constructed in place, but at outdoor stations it may be provided in the form of one or more prefabricated, prewired bungalows. A communication equipment room may be located adjacent to the signal equipment room, see Part IX H1.

3. The signal equipment racks are normally set up in rows running across the short dimension of the room. Aisles between racks are 5' wide, racks are 4' deep, and made up of units 2'-6" wide. At interlockings a local control board is provided in a separate fenced-off area. It should be possible to enter this area from outside without going into the remaining part of the signal equipment room.

4. Extreme care must be taken that seepage of water does not occur into signal equipment rooms. Doors should have locks and be sized to accomodate the passage of equipment. All signal equipment rooms must have both normal and emergency lighting. See Part XI-C for heating and ventilating requirements.

DESIGN STANDARDS

1. A communication equipment room should be provided at each station. It houses the equipment for the station public address system, closed circuit TV, the train radio system, fire or emergency detection, alarm and radio systems, and other systems used within, or tied-into the station. If possible, it should be located adjacent to the signal equipment room, but should <u>not</u> be entered from the latter.

2. A communication equipment room is typically 100 sq.ft. in area. The precise size is determined by the signal/communications designer. Space should be left for future equipment and system installations.

3. Extreme car must be taken that seepage of water does not occur into communication, equipment rooms. Doors should have locks and be sized to accomodate the passage of equipment. All communication equipment rooms must have both normal and emergency lighting. See Part XI-C for heating and ventilating requirements.

DESIGN STANDARDS

1. A third-rail disconnect switch or "B-Switch" should be provided for each track at the leaving end of the station platform. Thus it is located to be easily accessible to the motorman of a train on each track. It consists of a simple manually operated knife-switch which is used to disconnect the power feeding a segment of the third-rail through the station platform area, in emergency situations.

2. The switch is enclosed by a fibre-glass reinforced plastic box with hinged doors. It occupies an alcove 4' wide by 7' high by 2'-0" deep. Cables from the third rail are fed to the bottom of the box via large conduits. The box may be on the platform or just beyond the end of the platform, at the same level as the platform. There must be at least 4' clear between the face of the box and any fixed vertical obstruction opposite the box, to allow sufficient room for opening or closing the switch. The switch box may be exposed, or if on the platform, may be behind doors. The area in front of the switch should be lighted. No heating of the switch box or room is required, but doors if used, should be undercut.

3. Other traction power switches may be located near the station, sometimes adjacent to the "B-Switch". The number and location is determined by the traction power designer. The "B-Switch" and other switches may be grouped at the platform end with other service rooms, but the "B-Switch" should be easy to find in emergencies. If not visible from the platform a sign giving the switch number should be provided.

DESIGN STANDARDS

1. Sewage ejectors are required at locations where the sanitary drainage from the station must be raised to a higher level to feed into the city sanitary sewers. Pumps of various types are used to remove storm, water, seepage, and other water brought into the station or tunnel by the cars (rain or snow melt), from station washing, or from fire fighting, at all stations lower than the city or other storm drainage systems.

2. Typically the rooms are 75 to 150 sq. ft. in area. The room should be sized to provide adequate space for maintaining or replacing the equipment. Doors should have locks and should be sized to permit removal of equipment. Both normal and emergency lighting are required. See Part XI-C for heating and ventilating requirements.

DESIGN STANDARDS

1. Train Crew Lobby:

A train crew lobby is provided at any rail terminal where trains are stored. It is placed at the end of the platform closest to the storage tracks and may be at platform or track level. It usually will adjoin a large inspectors room located at the platform end. The size of the lobby depends on the personnel assigned to it, which will be specified by the Authority.

The train crew lobby must accomodate the following:

- A lunch room with tables, benches, kitchenette, space for 3 vending machines, and 50 sq. ft. of bulletin board
- A men's locker room with one locker per person, benches, and 1 shower stall.
- A men's toilet room with at least 1 urinal, 2 wc's, and 2 lavatories.
- A women's locker room with one locker per person per shift, benches, and 1 shower stall.
- A women's toilet room with at least 1 wc and 2 lavatories.
- A porters/utility room

It is desirable that the men's and women's locker rooms are designed so that by moving partitions and furnishings the size of the two rooms could be easily altered to adapt to a change in the ratio of men to women employees. Initially provide womens lockers equal to 10% of the number required for mens.

2. Yard Crew Lobby

A yard crew lobby is provided at any rail terminal where trains are stored. It may adjoin the train crew, lobby, oriented toward the storage tracks, and preferably at track grade. If the storage yard is some distance from the station, the yard crew lobby may be located closer to the throat of the storage yard, than to the station. The yard crew lobby is much smaller than the train crew lobby. The number of employees will be specified by the Authority.

DESIGN STANDARDS

The yard crew lobby must accomodate the following:

. An office for the yardmaster of 100 sq.ft.

. A lunch room with tables, benches, kitchenette, space for 1 vending machine, and 20 sq.ft. of bulletin board.

. Separate mens and womens locker rooms and toilet rooms similar to the train crew facilities except smaller. Toilet rooms would have only 1 of each type of fixture.

. A porters/utility room.

For heating and ventilating requirements for train and yard crew lobbies see Part XI-C. Finishes, lighting, and furnishings should be extremely durable, and easily cleaned.

At some locations it may be possible to consolidate the train crew and yard crew lobbies in a single facility. Common lunch rooms and toilet rooms are permitted. Separate train and yard crew locker rooms are required.

3. Walkways & Platforms at Storage or Turnback Tracks:

Paved, lighted walkways will be provided to connect the train and yard crew lobbies with the storage yard. Location of walkways must be coordinated with track and 3rd rail lay-outs to minimize the number of gaps in the 3rd rail.

Raised platforms at least 3' wide between tracks, and 2' wide if adjacent to a wall, will be provided at the storage tracks, as directed by the Authority. Steps to the ground are provided as required.

1. Storage Rooms:

Storage rooms may be provided at or near station lobbies, at train platforms, at busways, or within parking garage structures. Size, location, and requirement for utilities, heating, and ventilating will be specified by the Authority. Typically one room of 100 to 200 sq.ft. is provided at terminal stations.

2. Sand Boxes:

At outdoor train and bus platforms, and at other extensive walkway or roadway locations where ice conditions could exist, sandboxes should be provided. They should be 5'-6" long x 2'-6" wide x 3'-0" high, of concrete construction with a hinged steel top. They may be built-in in combination with other platform service rooms or furnishings, or as free-standing precast units.

3. Emergency Exits:

See Part IV-E Components

4. Platform/Track Access Stairs

Stairs to connect platform and track levels will be provided at each end of a platform. Min. clear width is 2'-0", minimum tread 9½", maximum riser 7½". If it is not possible to use a stair meeting these criteria, a 2'-0" wide ships ladder, and in the worst case a 2'-0" wide vertical ladder with maximum tread spacing of 1'-0" may be used.

5. Vent Shaft & Fan Rooms:

See Part XI Ventilation and IRT Ventilation Handbook.

1. Water supply is from city mains, with meter located in a service area. Water is required at toilets, porters' rooms, drinking fountains located in starters and employees' locker rooms, and at some concessions. Hose bibbs should be located throughout the station at approximately 100 foot spacing, so that most areas can be reached with 50 feet of hose. When possible, the hose bibbs should be located in service areas such as porters rooms, but <u>not</u> in electrical, signal or communication rooms.

2. Hose bibbs shall be of frost-proof, vandal-proof design. Heat trace all water and drain lines subjected to below freezing temperatures.

<u>WATER SUPPLY</u>

All subway tunnels and stations will be equipped with a dry standpipe system to aid the fire departments in fighting subway fires. The system consists of connections at street level which are fed by pumpers, vertical pipes dropping down to the subway level, horizontal runs through tunnels and stations, and hose connections at frequent intervals within the subway. The system must meet the following criteria.

a. Pipe:

Schedule 40 black iron grooved ends for victaulic or equal fittings. Mains shall be maximum 6 inch nominal size.

b. Fittings:

Victaulic or equal except that terminals shall be two, 2½" nominal size valved hose connections threaded to drop from main. Street level connection for pumper service shall be per Fire Department standard.

c. Location:

The two, 2½" valued hose connections shall occur every 100 ft. for each track unless access between tracks is provided at a minimum of 100 ft. intervals. The same spacing for outlets shall apply to stations. Street level connections shall be provided at stations and vent shafts. Street level connection shall be reasonably accessible to Fire Deparment equipment.

d. Identification:

Pipe shall be painted red. Street level connections shall be identified by signs.

e. Interference:

A minimum 6 inch clearance shall be maintained between the train dynamic envelope and any part of the dry standpipe fire.

DRY STANDPIPE SYSTEM

A set of signal lights will be provided at busways to indicate that a train is approaching the station. It should be located to be visible to all drivers of buses waiting at the station, and to the bus starter. It is part of the Signal System and usually lights-up when a train enters the previous station, thus is 2 to 3 minutes from the station where the busway is located. It is most useful in the off-peak hours when bus service is infrequent, as it allows a bus to be held several minutes beyond it's scheduled leaving time so that passengers from the next train can make a bus connection.

TRAIN APPROACH INDICATOR

1. For cleaning and maintenance equipment, vandal-proof 110V AC convenience outlets (equal to Arrow Hart 5797) are required at platforms, spaced about 50 feet on center. Actual spacing and mounting height will be determined by the elevations of the particular station. At mezzanines, a similar convenience outlet should be wall-mounted at each collection booth.

2. In new and modernized stations underfloor electric ducts should be installed, beneath the bank of turnstiles and to other likely locations of future automatic fare collection equipment. These ducts can be used at present to feed collection booths and fare boxes, and should be installed in groups of three, one duct each for AC, DC and signal wiring. Each of the three ducts should be connected by conduit to the nearest electrical room. A large junction box should be located at the termination of the duct system in each collection booth.

MISCELLANEOUS ELECTRICAL

1. Sound System. See Part VIII: Acoustics.

2. An ADT Alarm is required on the safe in most primary collection booths. It is not required on the safe in the safe room. This alarm is connected via the telephone line to the ADT Central Office.

3. All collection booths and all starters' rooms shall have telephones, connected to the central MBTA switchboard.

4. A starter's call bell system shall be installed, actuated by push button at any collection booth. The bell should be located at a central point in the station, and elsewhere as may be required in a particular station.

5. The opening of an emergency exit shall actuate an alarm located in the primary collection booth, and in the starter's room.

6. Public telephones may be installed in fare collection lobbies (normally in the free area), at station entry areas, at busways and at kiss and ride areas. Wall or post mounted units of vandal resistant design will be used.

7. Fire alarm boxes will be located at fare collection lobbies, train and bus platforms, and parking garages, as required by the fire department of each municipality.

8. Smoke and fire detection systems will be installed in all concession areas, rooms housing electrical equipment and other spaces as directed by the Authority. They will be connected with the Authority operations control center, and may be tied into the municipal fire alarm system as determined by the fire department.

COMMUNICATION AND ALARM SYSTEMS

1. A television surveillance system will be provided for at each station. It will include cameras at appropriate locations and a conduit system connecting the camera location and the primary collection booth with the station communications room. Additional conduit will lead from the communications room to the tunnel or wayside cable system to provide a connector with monitors at the operations control center. Cameras should be located to provide surveillance of platforms, passageways and other public areas which can not be observed directly by the collector. Additional monitors may be located at the collectors booth or other locations in the station which are manned during normal operating hours.

2. The station designer is responsible for planning the camera locations and the conduit system conduit and junction boxes will be installed by the station electrical contract. Design and installation of the TV equipment will be done under separate contracts for an entire route or group of stations and will provide a complete system of station equipment wayside connecting cables and monitoring system at the operations control center.

TV SURVEILLANCE SYSTEM

MANUAL OF GUIDELINES AND STANDARDS

Part X of the Manual describes environmental and functional criteria for new rapid transit stations. New stations will occur either at the surface or underground. Existing underground stations have been discussed in detail in the previous nine parts which also contain material pertinent to surface stations. "Surface" applies to stations located below, at or above the normal grade level of the site which are largely open to the outside.

The following other parts of the Manual give information necessary for an understanding of Part X.

Part I — Guidelines and Principles
- A. Circulation
- B. Openness (Platform Openness)
  (Openness to Neighborhood)
  (Daylight to Platform)
- D. Platform Elements (Required Car Clearances)
  (Sightlines)
- E. Defined Spaces
- F. Platform Walls (Side and End Walls)
- H. Advertising and Graphics (Advertising Locations)
  (Sign Locations)
  (Map Space)

Part III — Station Modernization Program

Part IV — Components
- B. Fare Collection - Standard Fare Layout
- C. Station Furnishings

Part V — Graphics
- A. Authority Symbol and Name
- B. Color Coding
- C. Lettering
- D. Maps
- F. Station Entering Signs
- G. Station Exiting Signs
- H. Platform Photomurals
- I. Miscellaneous Signs
- K. Bus Stop Signs
- L. Revenue Advertising

Part VI — Lighting
- A. Lighting Design
- B. Fixture Types

INTRODUCTION

PART X - Site Planning and New Stations

D. Station Lobbies and Platforms

Certain objectives have been established for the location of transit extensions. These objectives are the result of regional studies conducted jointly by the Authority and various state and local agencies. These objectives are as follows:

1. Routes that complement major highways, renewal or other public works.

2. Routes that promote economic development and stabilization of individual communities.

3. Routes that reach into a large and active transit market.

4. Routes that replace costly, lowspeed, or inconvenient local systems.

The station site location and general configuration will be determined by the Authority. The basic street and track alignments will be furnished to the station architects.

GENERAL

A transit station may be part of a larger urban development incorporating commercial, housing and light industrial uses.

The Authority cannot build structures for commercial purposes, but may sell air rights to other public agencies or private developers. Structures developed in coordination with stations provide the following advantages:

1. A total integration of the transportation system within the physical structure of the community.

2. An increase in Authority revenues by development of traffic generating activities at or near stations. Examples of these activities are high density residential or commercial development.

3. An indirect increase in Authority revenues by creation of safe and pleasant surroundings for the stations.

4. An improvement of Authority operations by providing new facilities which might not be available by other means, such as weather protected busways or storage yards.

5. The provision of space for special uses such as low rent housing, housing for the elderly, or public facilities, in communities where land for such uses is in short supply.

6. Through the sale of air rights or excess property, the receipt of funds which may be applied to further capital improvements of stations and facilities.

Because of the extreme urgency of completing some parts of the expansion program, it will not always be possible to arrange for air rights development to occur simultaneously with station construction. The station structure and site should be developed with enough flexibility to permit air rights development at a later date.

SITES IN STRUCTURES

The interconnection of the highway system and the mass transit system is necessary for a balanced transportation system. The location of transit stations at these interconnecting points provides a further reinforcement of both systems.

The rapid transit routes incorporated in the Authority Master Plan connect with the expressway and critical highway network in two ways. The first is a right angle intersection of expressway and transit line. An example of this type is the Riverside line's connection to Route 128. Here the highway becomes a major feeder to the transit station. The second is a transit line paralleling the highway. An example of this type is the Southwest Corridor. Here the expressway will feed the transit at the rail terminal and one or two other locations, but the arterial roadways crossing the joint transit corridors will feed both modes at many points.

An expressway location presents special problems. The majority of people will arrive by automobile or bus. The driver will be traveling at high speed and must be signaled of the approaching entrance to the transit station.

Station elements may be placed directly beneath elevated sections or above depressed sections of the expressway. Such locations require strong visual elements to compete with the scale of the expressway and the speeding traffic. Elements that span the roadway or project vertically beside or between the roadways can provide these focal points.

The station may also be located adjacent to the expressway where it is more visible. This scheme simplifies parking and approach roads, but requires more land.

The exit lanes from the expressway to the station should be located on the approach side of the station, with the station visible from the point of exit. Sight lines to the station may be improved by curves or slopes in the roadway.

Bibliography:

Appleyard, Lynch & Meyer, View from the Road, MIT Press, Cambridge, 1963

EXPRESSWAY SITES

While level sites are best suited for intense activity, activity alone will not insure the success of a level site. A suburban station on a level site may become an island in a sea of vehicles.

Planting, manmade landforms, changes in surface texture, and the station structure can be utilized to define spaces, direct and orient circulation, and provide variety.

Sloping sites may be utilized to divide parking into small units, separate pedestrian levels from vehicles, screen unwanted views, define spaces, and increase the visibility of the station from the surrounding area.

The topography of each site will determine the organization of the plan. The location of circulation, the use of an area, the position of the buildings, and its visual aspects, will be influenced by the topography.

The following general scale of slopes should be followed for particular uses:

Slopes under 1% do not drain well
Slopes of 1% to 4% are desirable for intense activity
Slopes of 4% to 10% are suitable for informal movement and activity
Slopes over 8% are unfavorable for roads.

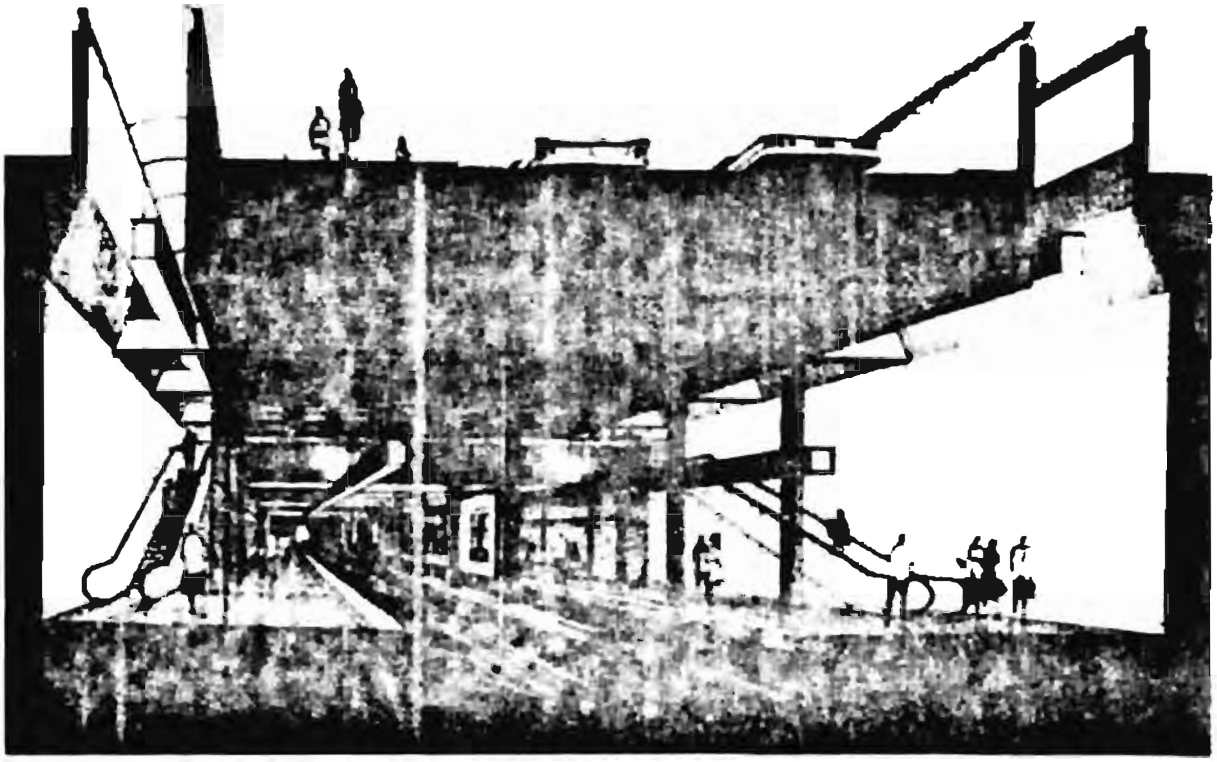
To provide level areas for parking, the sloping portions may be graded and the level areas developed in steps down the site. The slopes between these parking plateaus are then available for major planting such as trees. Areas of grass should be avoided unless maintained by local park departments. Brick, stone, concrete, etc. may be used where surface texture is desired. If plant material is desired for ground cover it should be a type that needs little attention. Landscaping should be kept simple and used in large enough areas to have impact.

LEVEL AND SLOPING SITES

Surface stations located in densely populated areas may be required to use smaller sites. Parking, if it is provided, will be based on site design limitations. If the area surrounding the site is architecturally noteworthy, the station should be suppressed so as to be sympathetic with these surroundings. Building set backs, existing height limitations, and the types of materials should relate to the local area.

In vast open areas or areas of little visual significance, the transit stations may be a strong visual element and a focal point for the whole neighborhood.

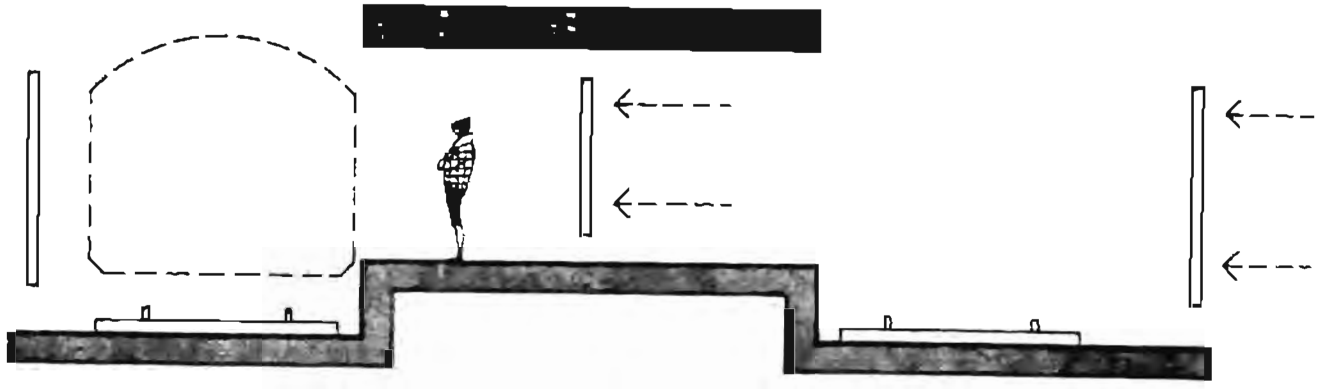
DENSE AND OPEN SITES



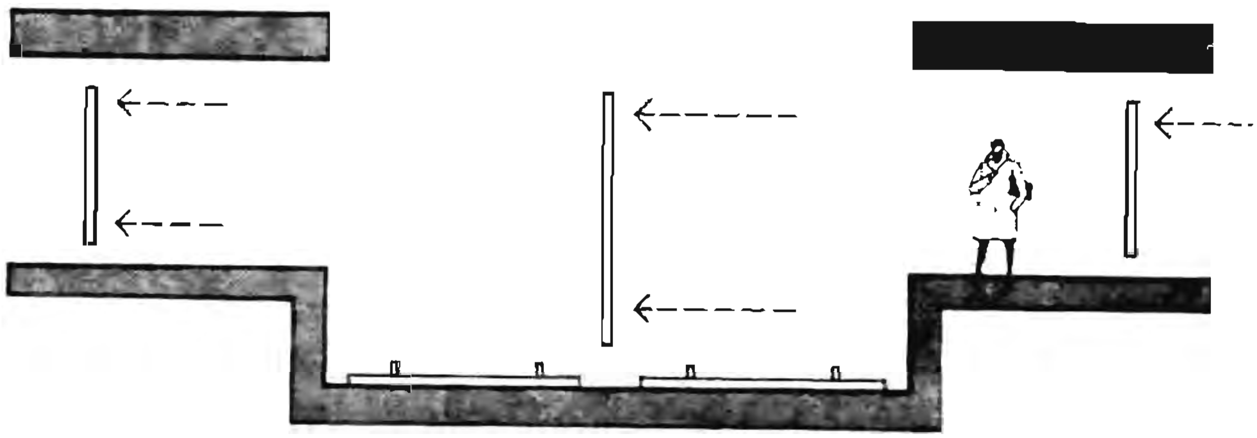
New underground stations should be light and airy. This can be accomplished by wide simply shaped platforms and high interior spaces. Daylight should be brought into underground stations by penetrating the surface. The new North Station, on the Orange Line, shown above, indicates one solution: sky lights to the street, allowing daylight to wash the side walls of the space.

Mezzanines or entrance lobbies at grade should wherever possible provide orienting views of the platform space. In the example shown above, a mezzanine fare collection lobby is located as a wide bridge within the platform space, providing pleasant views and awareness of platforms and trains below.

UNDERGROUND SITES



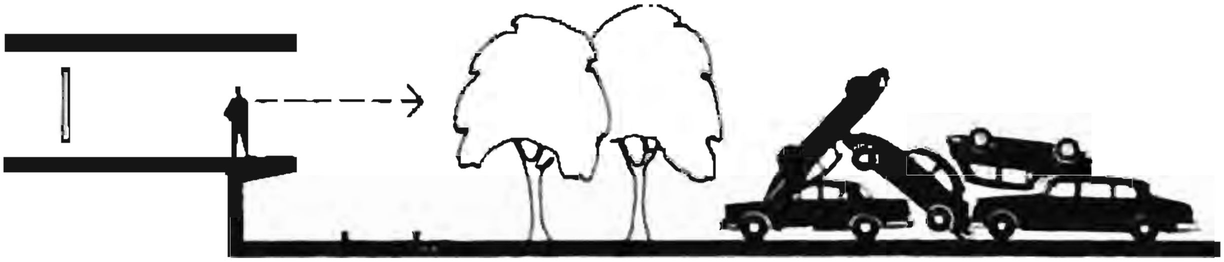
CENTER PLATFORM



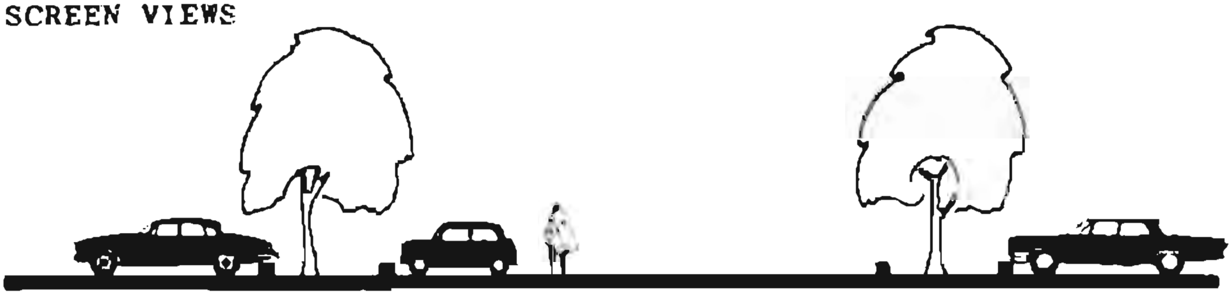
SIDE PLATFORM

Waiting passengers should be given protection from prevailing winds and sun angles. Panels may be erected as wind guards. These panels will also provide necessary surface for upper and lower name bands, maps, orientation photomurals, and revenue advertising. For precise standard locations of these graphic elements, see Sections I, III, V.

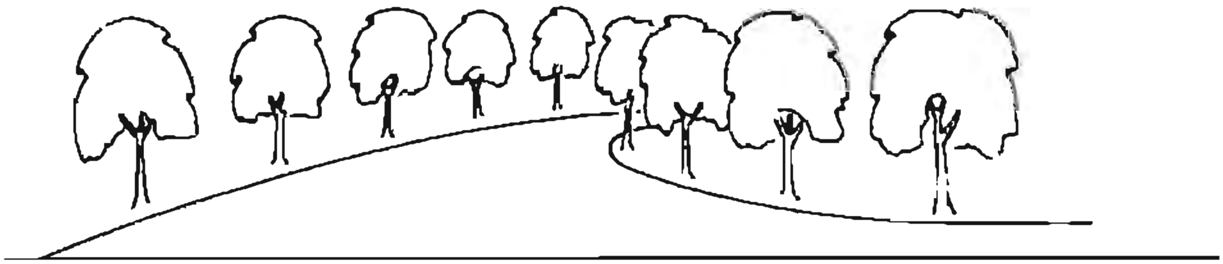
CLIMATIC CONDITIONS



SCREEN VIEWS



DIVIDE PARKING



SUGGEST DIRECTION

Existing trees should be preserved when possible. Trees and other plant material may be used to screen undesirable views, divide large parking areas into smaller units, or suggest a flow of exterior space.

Planting when used as surface texture and color should be limited to those types requiring minimum maintenance. Whenever planting is used it should be used in large enough areas or numbers to make an impact.

PLANTING

For further information refer to the following books:

American Association of State Highway Officials, Landscape Design Guide, pages 88-92

Army Corps of Engineers, Planting and Maintenance of Trees, EM 1110

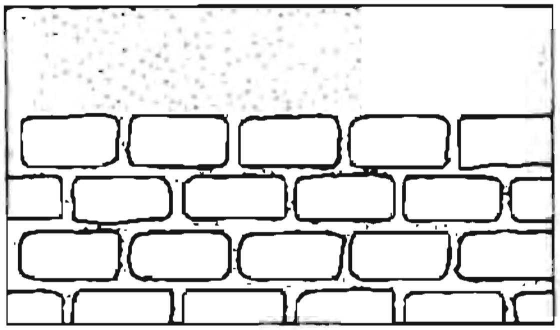
Fanlatan, D., Shaping Tomorrow's Landscape, Amsterdam, 1964

Lynch, K., Site Planning, MIT Press, Cambridge, 1963

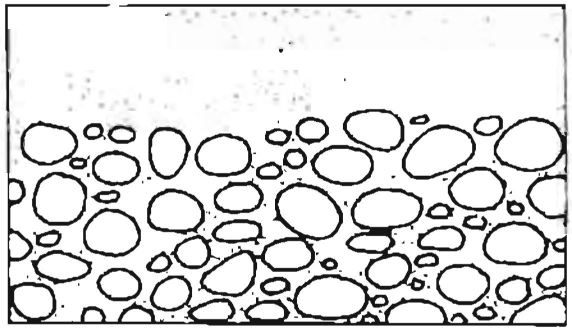
Urban Land Institute, Community Builders' Handbook, pages 152-153

Urban Mass Transportation Administration, Transit Planting: A Manual (UMTA Demonstration Project VA-06-0006)

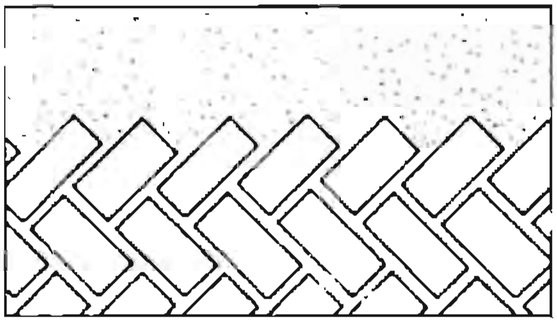
LANDSCAPE REFERENCES



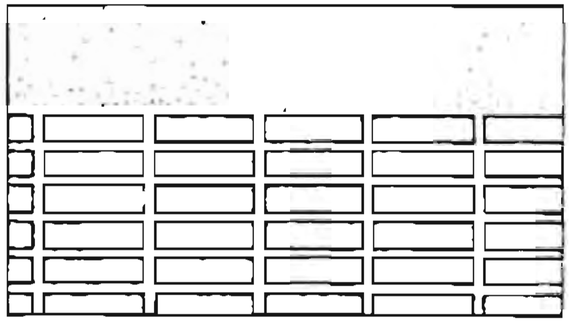
COBBLESTONE & BITUMINOUS



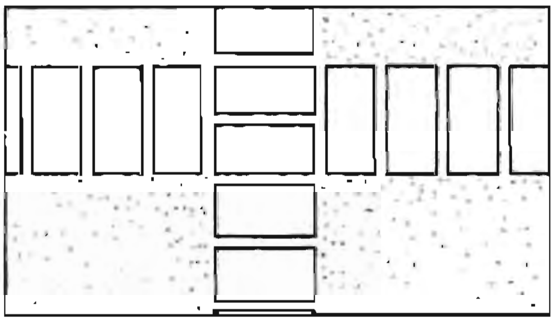
RUBBLESTONE & CONCRETE



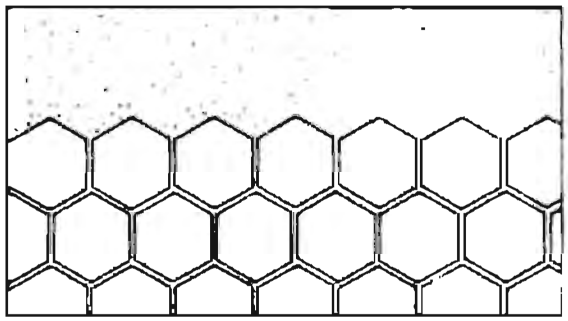
BRICKPAVERS & CONCRETE



BRICKPAVERS & BITUMINOUS



BRICKPAVERS & CONCRETE



BITUMINOUS PAVERS & CONCRETE

Surface textures other than grass should be used extensively. A change of surface texture may be used to denote pedestrian paths at crosswalks and within parking areas. Vast areas of asphalt or concrete should be relieved by introducing strips or areas of contrasting material. Concrete and asphalt may be used together. Loose crushed stone or gravel should not be used in areas accessible to the public. Where a hard surface is not desired, wood chip mulch may be used alone, or in combination with planting.

SURFACE TREATMENT

The type of lighting and the light intensity will be determined by the function of the area.

Lighting for the pedestrian should be in scale to the human figure. Rows of lights may be used to indicate direction or define paths. Lighting in parking areas should be of a quality and intensity, preferably high pressure sodium, to impart a sense of safety. Self-parking areas and paths require one footcandle of illumination. Large parking areas should be 2-3 foot candles.

Direction and information signs may be brightly backlit for contrast. Surface illuminated sign boards need fifty foot-candles on dark surfaces. Backlit signs should be used whenever possible as they are more easily seen at night than surface illuminated signs. Care in placement, color selection, and intensity of light will be necessary to avoid washing out colors and graphics.

Light fixtures should be as vandal resistant as possible, with polycarbonate or high impact acrylic diffusers, particularly those which might be within reach of pedestrians.

Poles should be heavy gauge, extremely rigid, with hand hole and fixed base.

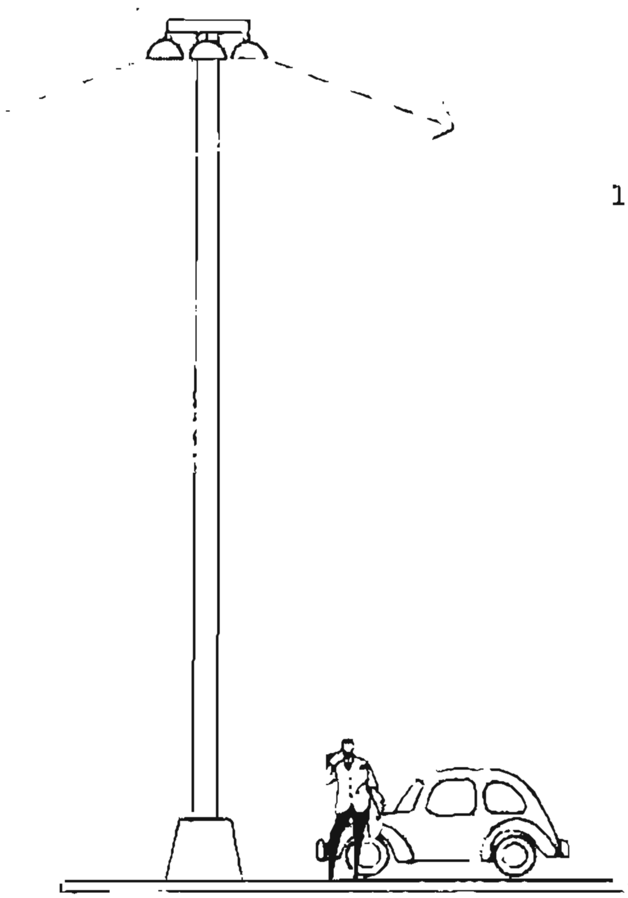
All wiring for exterior lighting fixtures should be buried in plastic coated rigid steel conduit. Overhead wiring will not be permitted.

For large areas, parking, train and bus storage, etc., serious consideration should be given to high mast lighting to minimize number of poles and luminaires. High mast installations should be of type that permits lowering of the luminaire assembly to ground level for servicing.

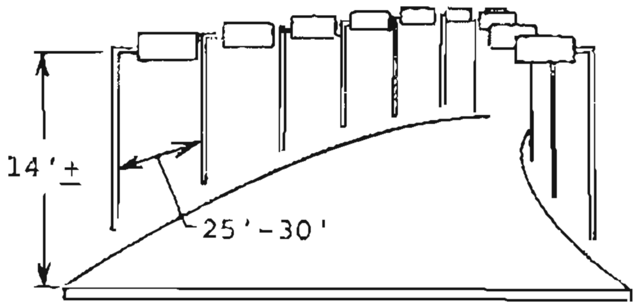
Maximum mounting height of fixed luminaires shall be forty (40) feet to permit servicing by bucket truck, where truck access is available.

Ease of maintenance of <u>all</u> fixtures is of prime concern.

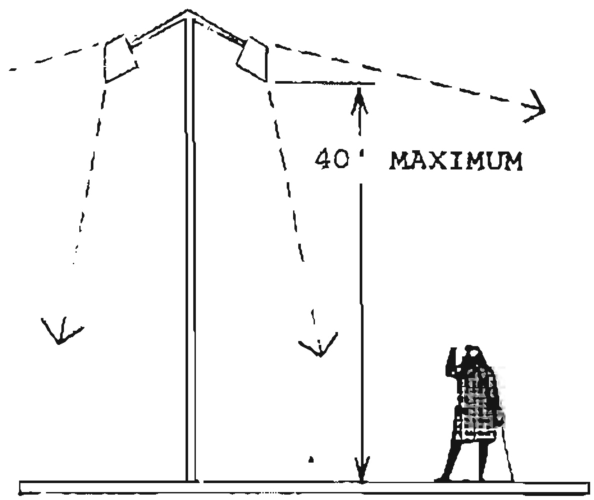
EXTERIOR LIGHTING



HIGH MAST LIGHTING
(LARGE AREAS)



LIGHT TO INDICATE DIRECTION



HIGH INTENSITY HIGH LEVEL

EXTERIOR LIGHTING FIXTURE TYPES

The amount of traffic and the mode of arrival will shape each site and station in a different way. Each mode has its own characteristics and needs which are fully described below. The modes are: pedestrian, bus, auto drop-off ("kiss and ride"), park and ride, and in several locations, railroad shuttle. Some stations must accommodate all of these modes; others only one or two.

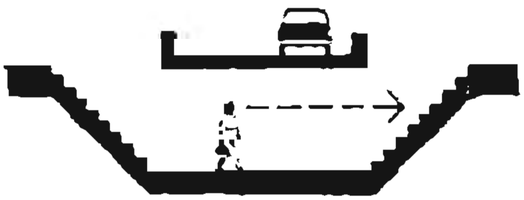
As one progresses along a transit route outward from downtown, the emphasis of the major mode of access to stations shifts from pedestrian to automobile.

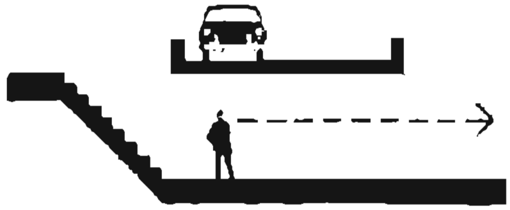
Typically, several modes feed a station - priority in terms of convenience of access to the station lobby should be 1) Pedestrian, 2) Bus, 3) Kiss and Ride, and 4) Park and Ride. At individual stations the order of priority may be modified to conform to the forecasts of the activity for a particular station.

Estimates of traffic by mode of arrival, and schematics of traffic flow patterns, are furnished by Planning.

GENERAL

Absolute segregation of pedestrian from vehicular circulation is not required, nor is it necessarily desirable except in high volume areas. The pedestrian values travel time and convenience over almost anything else, and will not use grade separation structures unless they are very convenient. Major pedestrian-vehicle conflicts should be avoided wherever possible, but must not unduly inconvenience the users. Walkways which are too isolated from other circulation can create problems in surveillance and policing during off-peak hours. Crosswalks should be well marked with stripes or by a change of materials. The safety of pedestrians must be assured where vehicles share the accessway.





Preferred

If possible, pedestrian overpasses or underpasses should be used where one end can be at or near grade. This minimizes the successive up and down movements, allows better surveillance, gives the pedestrian a sense of orientation, and is generally more pleasant.

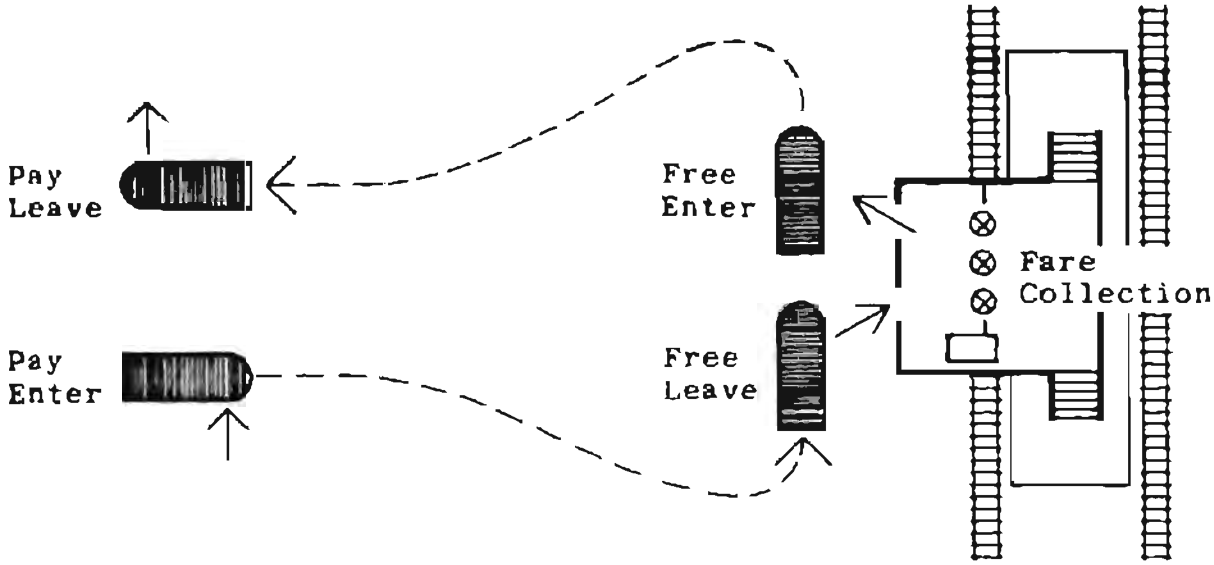
Pedestrian way - specific details:

Minimum width of unobstructed sidewalks:	5'
Minimum width of pedestrian crosswalks:	7'
Minimum width of pedestrian bridge:	8'
Minimum width of pedestrian tunnel:	10'
Maximum slope of pedestrian ramp: Preferred slope of 1:15	1:12

Roadways over 4 lanes in width require a pedestrian refuge area at least 4' wide

Minimum headroom for short distances	7'6"
preferred minimum	8' to 10'

PEDESTRIAN



The present fare collection policy of the Authority allows free entry to buses at rapid transit terminals, the passenger pays as he leaves the bus outbound. Inbound to a rapid transit terminal, he pays as he enters the bus and exits free at the terminal. This system minimizes loading and unloading times at the terminals where time and space may be critical. A separate additional fare collection is made in the station lobby for the rapid transit ride.

Bus routes may operate through or adjacent to a station, or terminate at a station. Bus loading facilities at a transit station may be on-street or off-street. Either type of route can be served by either type facility, though through routes can often be better served by on-street stops.

Generally, when traffic volume at a single stop for terminating buses (with space for 2 buses) exceeds 12 per peak hour, off-street bus loops should be provided. The required number of berths will be determined by the Authority.

There is no typical bus terminal layout. The amount of bus traffic, possible points of street access, configuration of available site, and topographic relationships will dictate the layout of bus facilities in a different way for every transit station.

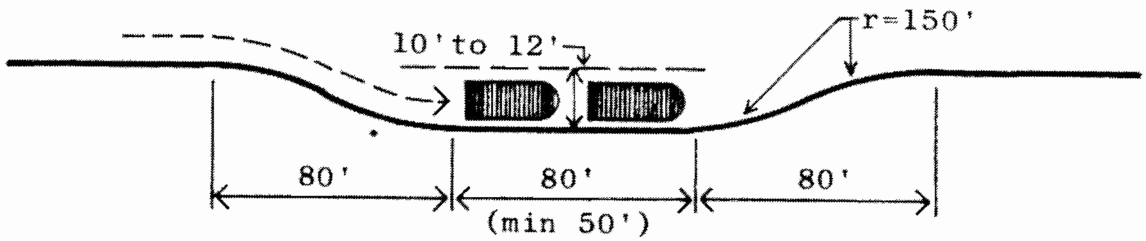
BUS FACILITIES - GENERAL

As the bus to train transfer is a breakpoint in a journey, it involves penalties in travel time and inconvenience. Thus, everything within reason should be done to make the transfer quick and easy. Unless otherwise specified, buses should have prime access to the station entry lobbies, taking priority over other vehicular access modes. All bus stops must be designed for right-hand loading. The pedestrian route from bus to train should be direct and involve a minimum of stair climbing. Liberal use should be made of shelters. Bus terminal areas should be well ventilated, illuminated, and designed for easy surveillance. The terminals must be planned to permit easy bus-to-bus as well as bus-to-train transfer. Conflicts with other access modes should be minimized.

The passengers movement and wait in the station should be as pleasant as possible. Benches, wind screens, and platform heating will increase passenger comfort.

An advantage of on-street bus stops at transit stations is that in some instances they can offer shorter overall travel time for the rider. Site considerations or traffic conditions could make it difficult to provide convenient off-street bus loops that would get the passenger to the station faster than he could walk from an on-street stop. Both solutions should be studied and the most convenient recommended.

At on-street bus stops, a pull-out lane at least 10' but preferably 12' in width, and long enough for at least 2 buses, should be provided, where possible.



Bus routes terminating at a station may stop in the street at the station and go beyond the station to turn around a block or public square. It is preferred, however, to provide turn around space for the buses on the transit station property.

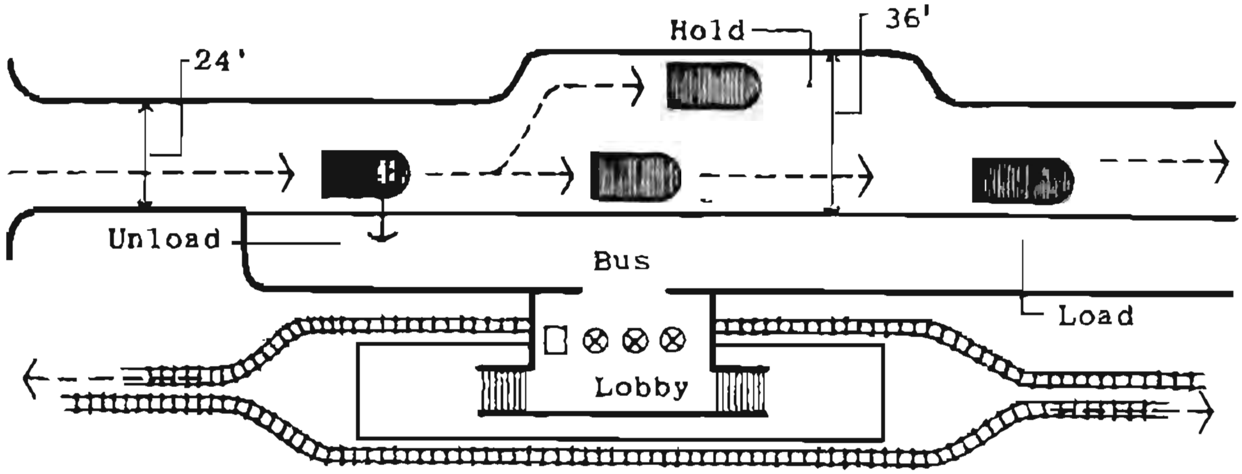
BUS FACILITIES - ON-STREET

At stations of low traffic volume, those with less than 12 terminating buses per peak hour, buses may share parking area roadways with the kiss-and-ride and park-and-ride traffic. For volumes greater than 12 per peak hour, buses should use special lanes or roadways for unloading, waiting, and loading. Thus, conflicts between buses and automobiles using parking and kiss-and-ride may be avoided. All busways should be designed to permit a bus to pass a standing bus (see dimensions below). Buses should never be required to back-up in the station area.

The ideal bus station should be laid out so that terminating buses may: 1) unload, without delay, 2) pass through a holding area, where they can wait if their loading berth is occupied, and proceed to a loading berth for normal layover and boarding. Unloading bus passengers should have short, direct access to the station lobby. There should be a loading berth for each major bus route, though heavily used routes may need two berths, while very light routes can double-up at a single berth. A loading berth should be able to serve approximately 10 to 12 buses per hour. Only where bus volume is relatively light, or where buses run through the station, can they unload and load at the same stopping point, though extra length for "bunching" should be provided.

The advantage of allowing buses to layover at the loading berth is that passengers may wait in the bus.

BUS FACILITIES: OFF STREET - GENERAL

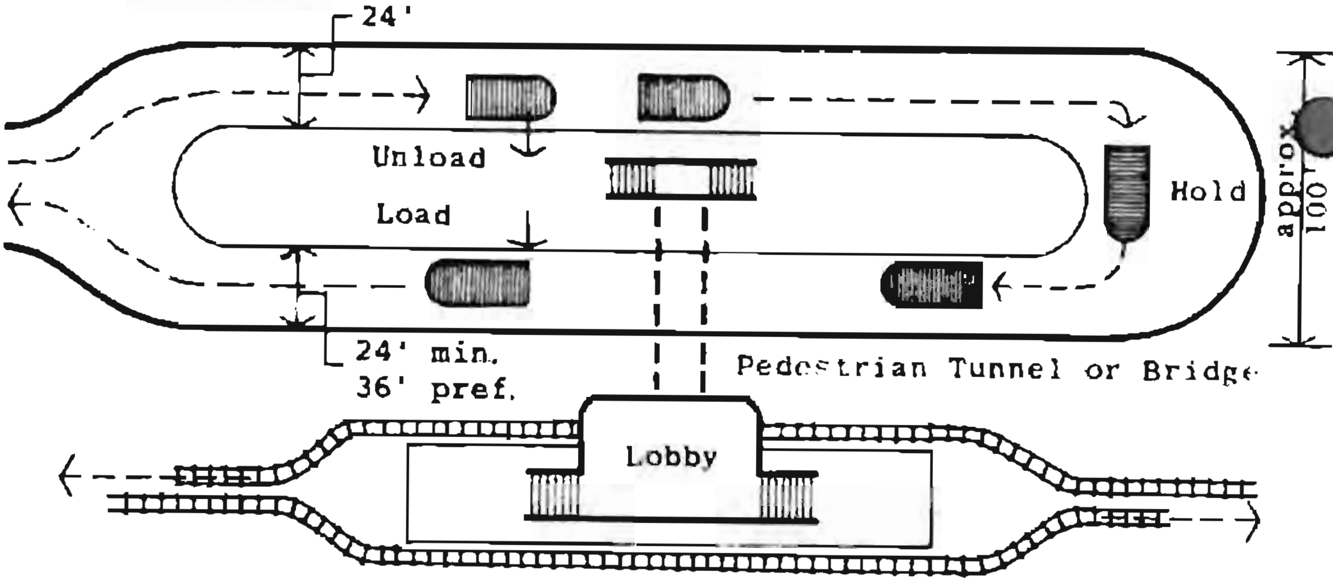


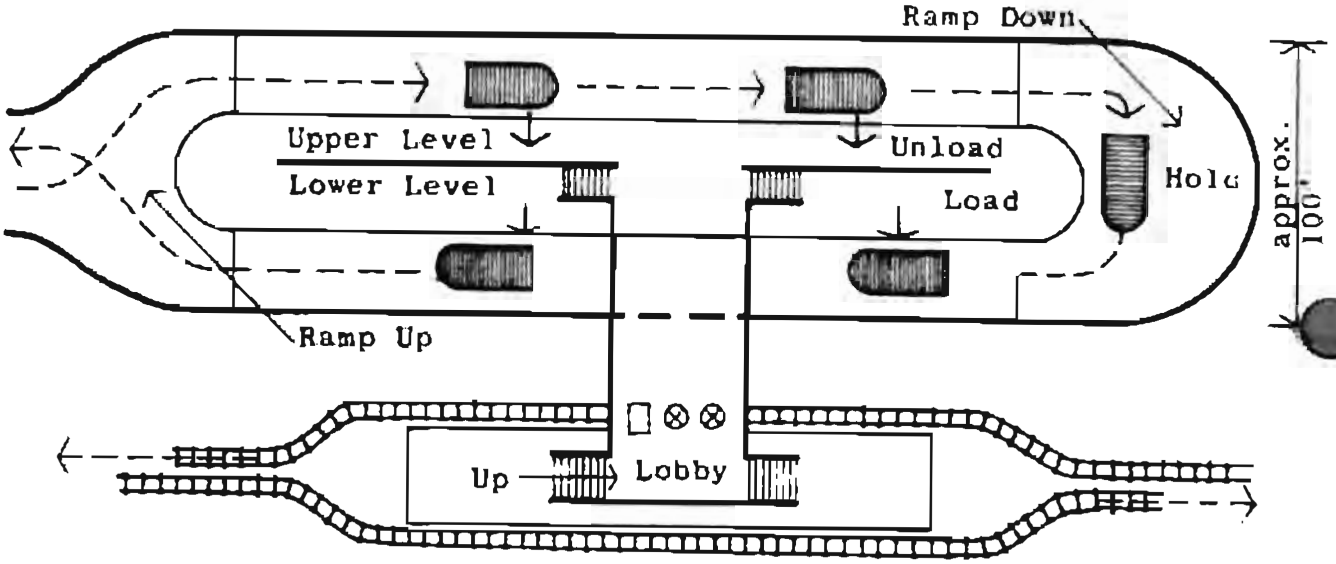
The layout shown above permits direct pedestrian access to the lobby without use of stairs or escalators.

As the time spent at the unloading area is relatively short, one unloading berth can serve 3 or 4 loading berths. Unloading buses can stop bumper to bumper. Shortcuts for empty buses to go directly from the unloading area to the outside to return to a garage, or from the outside directly to the loading area, are a desirable but not mandatory extra feature. Loading areas should be designed to permit a loaded bus to pull out of a berth and pass other standing buses.

The ideal bus flow pattern shown can result in an excessively long station if many routes must be handled. Thus, it can be advantageous to compress the flow pattern by various means, as shown on the following pages.

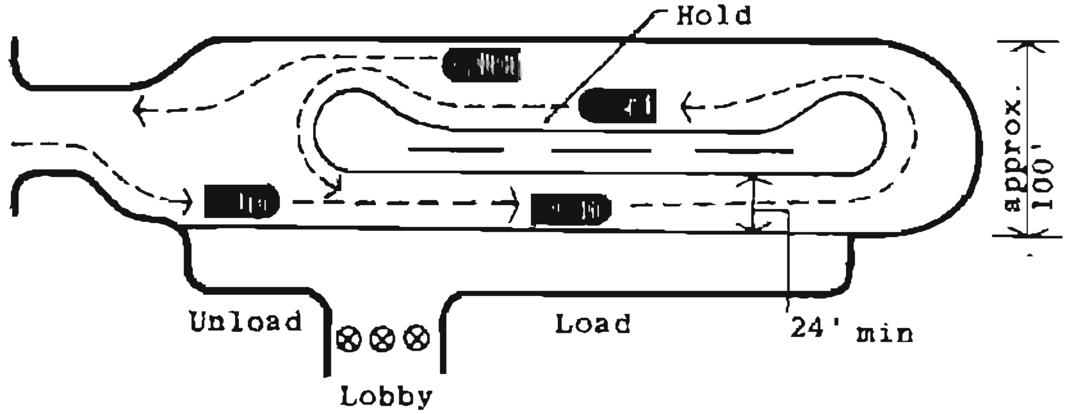
BUS FACILITIES: OFF STREET - IN-LINE FLOW



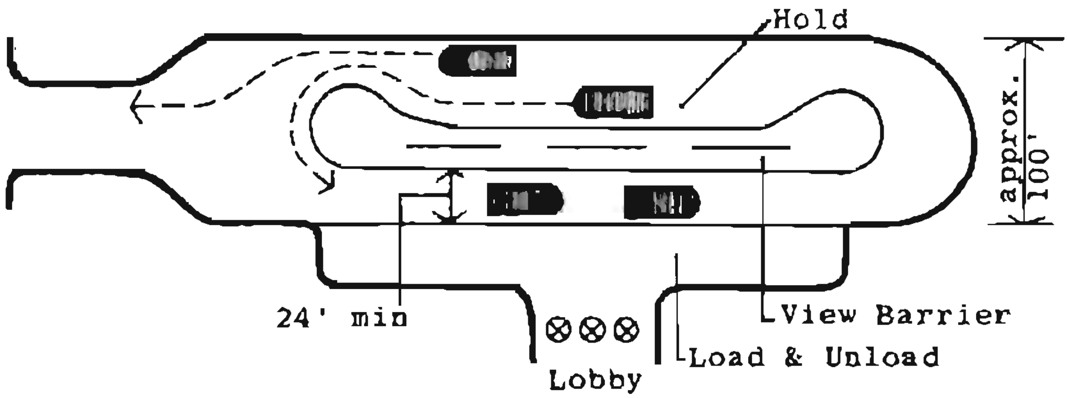


In the schemes above, buses go clockwise around an island with unloading on one long side, storage at one end and loading on the other long side. This scheme works well when access to the lobby is via pedestrian underpass or overpass. A split level variation of this pattern is also possible. The example shown has the advantage of reducing the need for stair climbing as buses can unload on the upper level with direct lobby access, and load on the lower level reached from the lobby via a down stairway.

BUS FACILITIES: OFF STREET - ISLAND FLOW



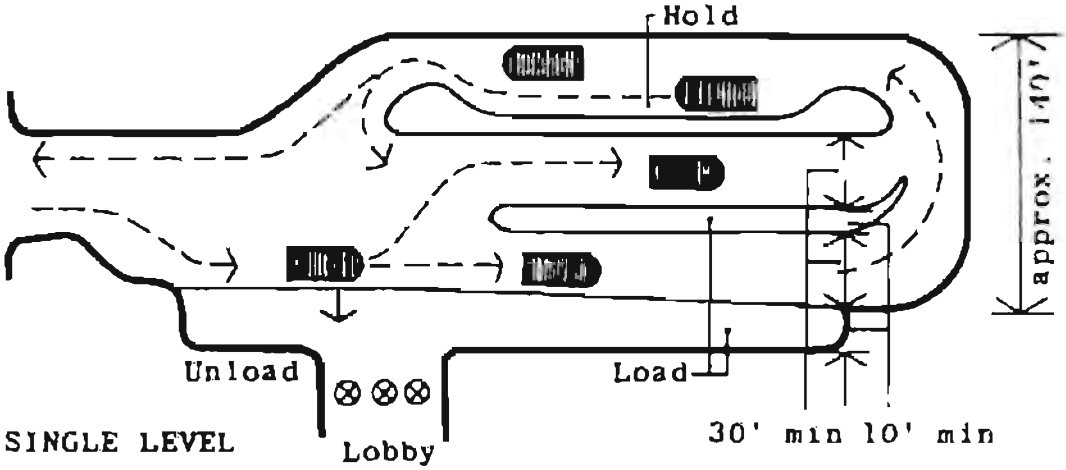
SEPARATED LOAD-UNLOAD

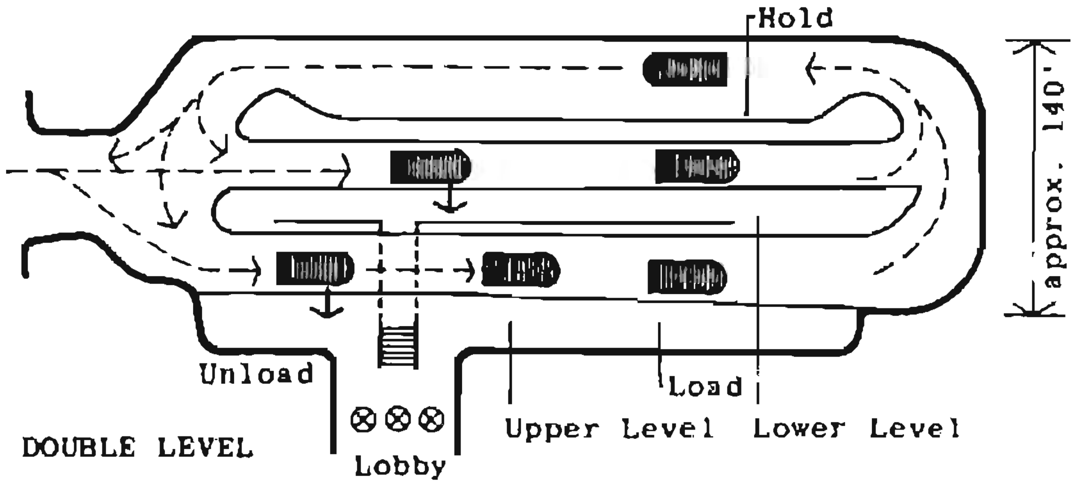


COMBINED LOAD-UNLOAD

Other methods of compressing the length of a bus facility are shown above. In some examples, it is necessary to slightly increase the empty bus mileage for those buses which cannot go directly from the unloading to the loading area as they must loop through the hold area. Also, at-grade crossing of the busway is necessary for some cases. This is not serious as long as proper sight distance and warning signs are provided. The advantage of these schemes is the saving of space and reduction of walking distance.

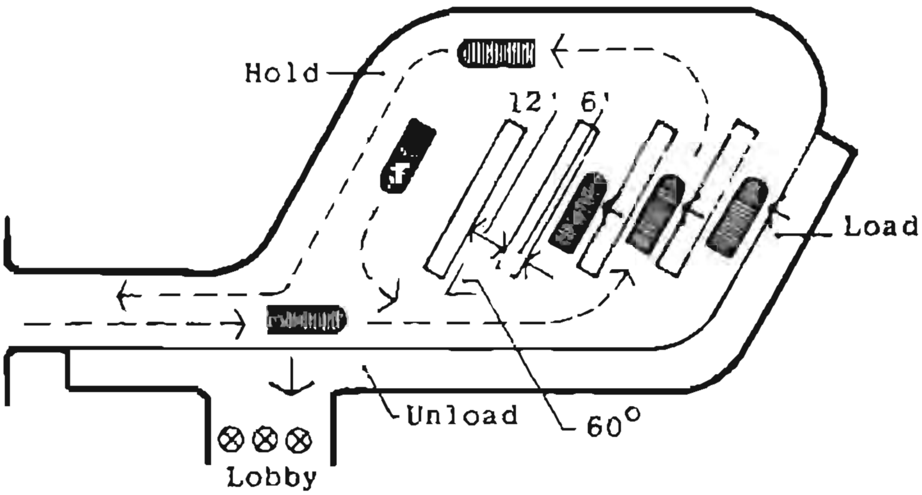
BUS FACILITIES OFF STREET - COMPRESSED FLOW

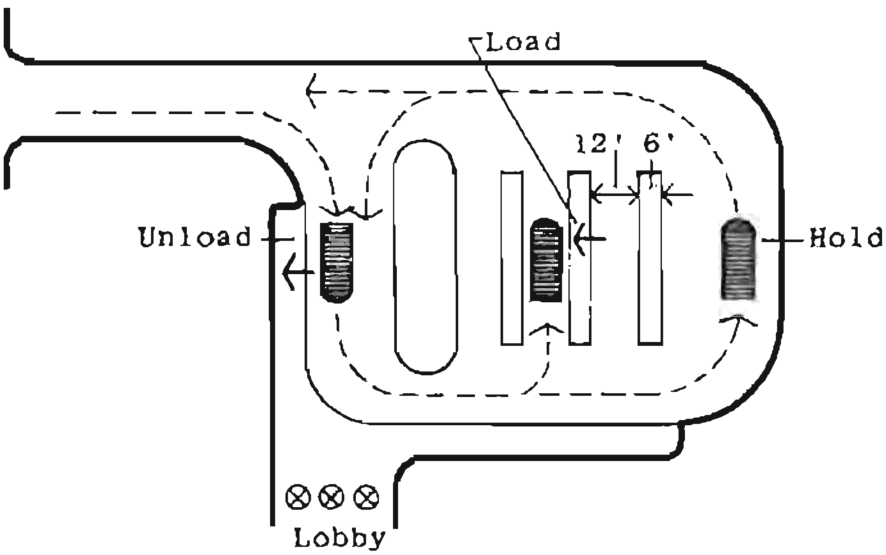




With the above scheme, the number of loading berths may be reduced by having buses layover in the hold area and stop in the loading berths just long enough to load. More routes can double up at a single berth this way.

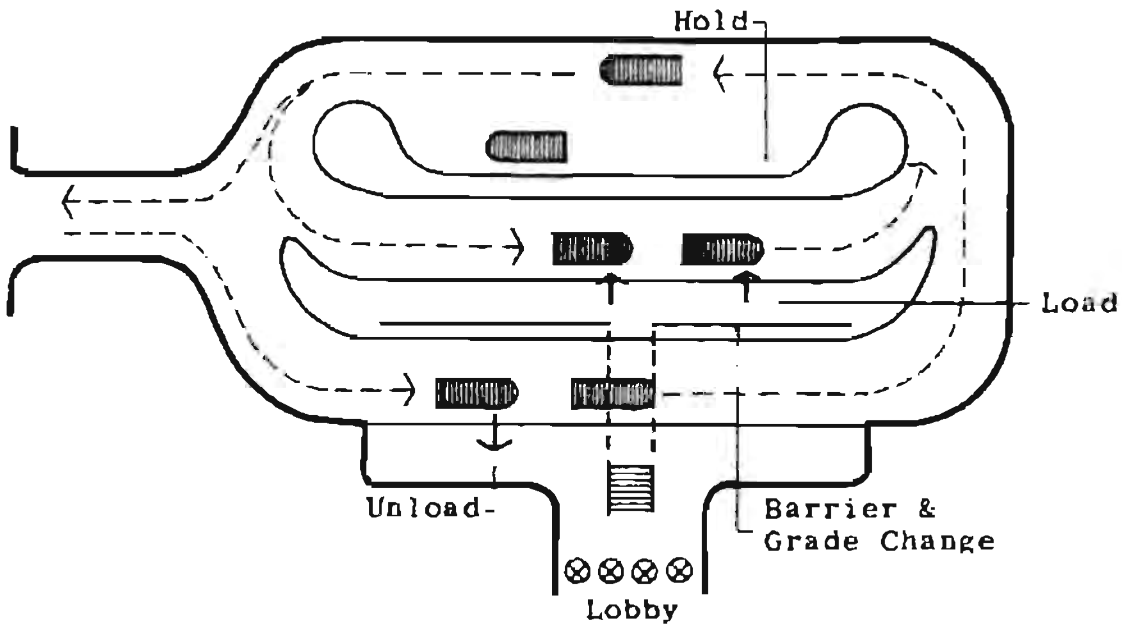
BUS FACILITIES - LONG ISLAND PLATFORMS





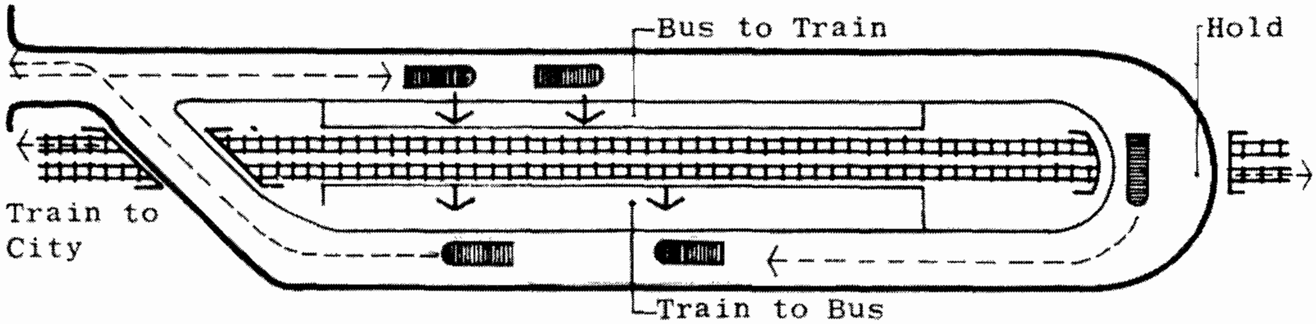
When space does not permit use of long in-line loading areas, a more compact arrangement, utilizing small island platforms, may be used. This system, however, leads to uncontrolled pedestrian crossings over a large part of the busway, and hence increased danger and possible movement delay.

BUS FACILITIES: OFF STREET - SHORT ISLAND PLATFORMS



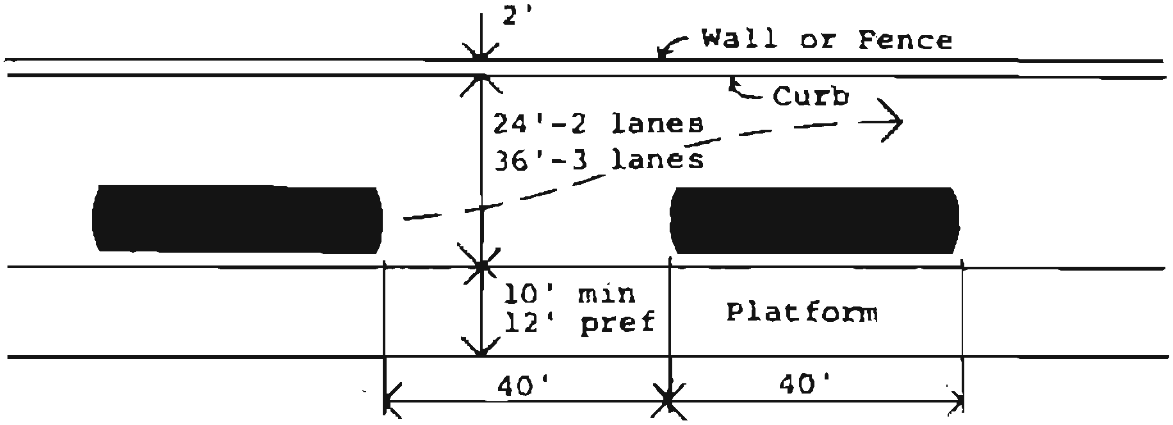
The scheme above involves intensive use of loading berths by many routes in a random manner. It requires a large platform for waiting passengers, an audio/visual system, and a traffic controller for identifying buses. This scheme offers short walking distances, but is more hectic for the rider due to the constant milling about on the platform. Buses may layover in the hold area in this scheme.

BUS FACILITIES: OFF STREET - RANDOM LOADING



Bus terminals with cross-platform transfer are found at a number of locations on the "T" system today. Though convenient for bus to train transfers, this layout as shown above, is generally inconvenient for all walk-in, kiss-and-ride, and park-and-ride passengers. As this system requires side platforms, two fare collection lobbies at platform level are required, except at rail terminals. This layout takes considerable length, as grade separations between buses and trains are needed at each end of the station, and also makes an inbound-outbound option difficult for loading or unloading passengers. In addition, it is too wide to fit into expressway medians or on rights-of-way shared with railroads.

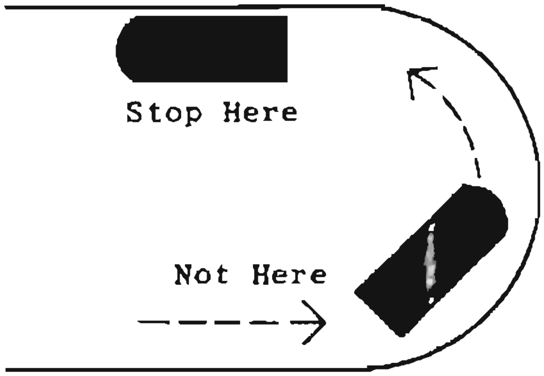
BUS FACILITIES - CROSS-PLATFORM TRANSFER



Typical Busway and Platform

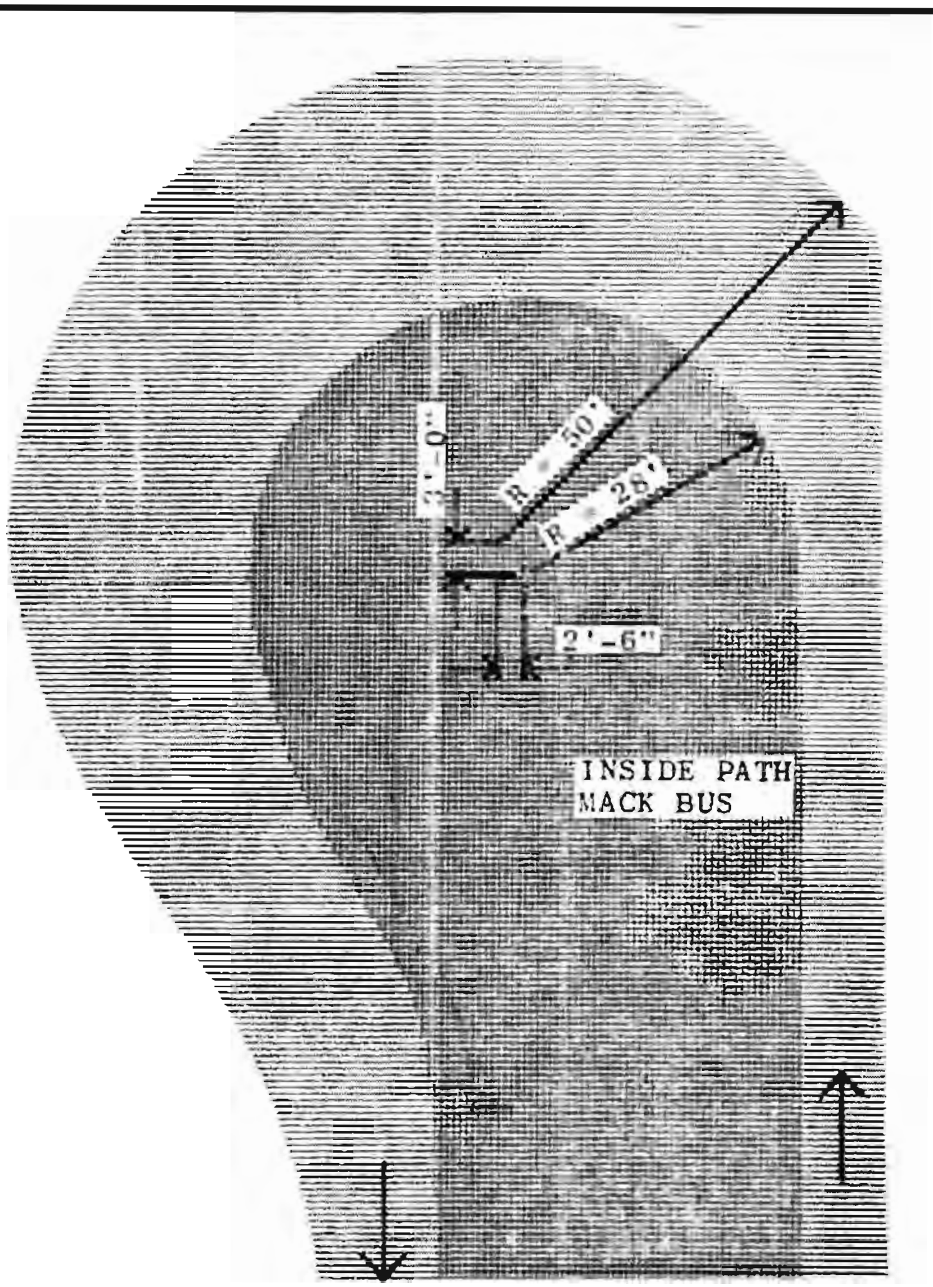
Minimum vertical clearance at busways should be 13'-6". Obstructions on the platform should be at least 6' from the platform edge. Shelter should be provided for unloading and loading areas. Benches should be furnished at loading areas. At heavy traffic stations continuous canopies should cover the bus platforms and connect with the lobby. At lighter traffic stations or stops, small free standing shelters should be used. Benches, maps, windbreaks, and at least one sheltered and heated space should be provided at bus loading areas at each station. See Parts I and IV for similar furnishings used on train platforms.

BUS FACILITIES: OFF STREET - PLATFORM DIMENSIONAL CRITERIA



Single lane busways should be avoided unless they are short and there are alternate paths available. The minimum width of a 2-lane roadway for moving buses is 20', and where buses stop, 24'. As is shown on the turn radius diagram, a turning bus sweeps a considerably larger area than a bus on a tangent path. If pedestrian traffic is adjacent to the outside of a tightly curving bus loop, a protective fence or stripe should be used to allow space for overhang of the front outer corner of the bus. Buses should not load or unload in the midst of a short radius loop or curve as they cannot get up to the curb, and waiting passengers cannot predict the path of the bus.

BUS FACILITIES - ROADWAY DETAILS

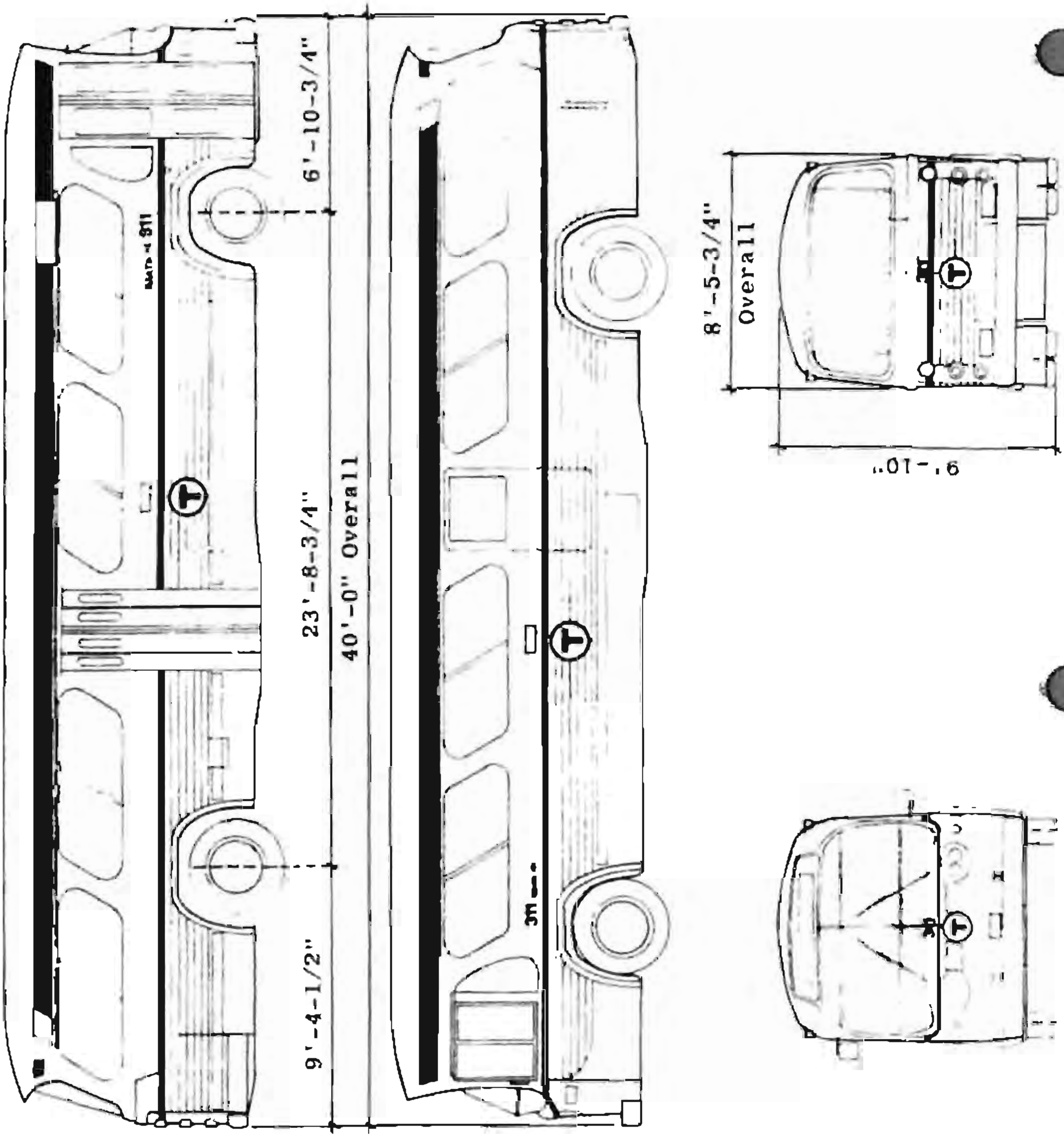


The minimum turning radius for the largest Authority buses is shown above. For ease of operation, larger dimensions than the minimum should be provided. Other data on geometric design of roadways, corners, median dividers, etc , can be found in "A Policy on Arterial Highways in Urban Areas", by American Association of State Highway Officials, Washington, D.C. 1957.

BUS TURNING RADII

Separate service facilities for bus drivers may be furnished at heavy volume stations. They include a toilet and washroom of 100 to 150 sq. ft., a lunch and locker room of 200 to 300 sq. ft., and a starter's office of 100 to 150 sq. ft. Access to operators' toilet, locker rooms, etc., should not be via the starter's room. These facilities should be at a location which is convenient to the bus loading area and surveillance. The starter's room is normally near the leaving end of the busway. They may be incorporated in the station lobby, but should be outside the fare collection line. At lighter volume stations the bus driver's facilities would be joined with those provided for station personnel.

DRIVER ACCOMMODATIONS



Principal dimensions and features of the largest buses now operated by the Authority are shown above.
(G.M. "New Look" etc.)

BUS DIMENSIONS

Park and ride requirements for each station are spelled-out by Planning. As a general rule, parking will be supplied at all stations outside of the high density central area. The amount of parking space at a particular station depends upon the traffic potential, the ability of the street system to feed the station, and availability of reasonably priced land. Generally, more parking space is needed at stations in the outer low density suburban areas where walk-in and feeder bus traffic is of minor importance.

The policy of the Authority at existing lots is to have pay parking, requiring a means of controlling entry to the parking area. Aside from producing revenue, pay parking helps limit use of the lot by non-transit riders, and through use of selective pricing, helps get maximum utilization of all lots along a transit route and to control use of areas within a lot, such as reserving space near the lobby for mid-day riders. At the present, station lots are operated by a concessionaire, with an attendant collecting the parking fee as cars enter the lot and must be flexible enough to allow the control to be at either entry or exit.

PARK & RIDE FACILITIES - GENERAL

From 30% to 60% of the cars parked at a station over 24 hours may arrive in the AM peak hour, depending on circumstances of the station location.

There may be surges within the peak hour with as many as one-third of the cars arriving or leaving in the peak 15 minutes. Entry and exit facilities should be dimensioned to handle this traffic. The capacity in cars per hour for an attendent or a mechanical toll collection device is 400 to 500 per hour, depending on the fee being collected. A pass system would be somewhat faster. Specific parking demand forecasts and other design criteria for each location are furnished by The Authority.

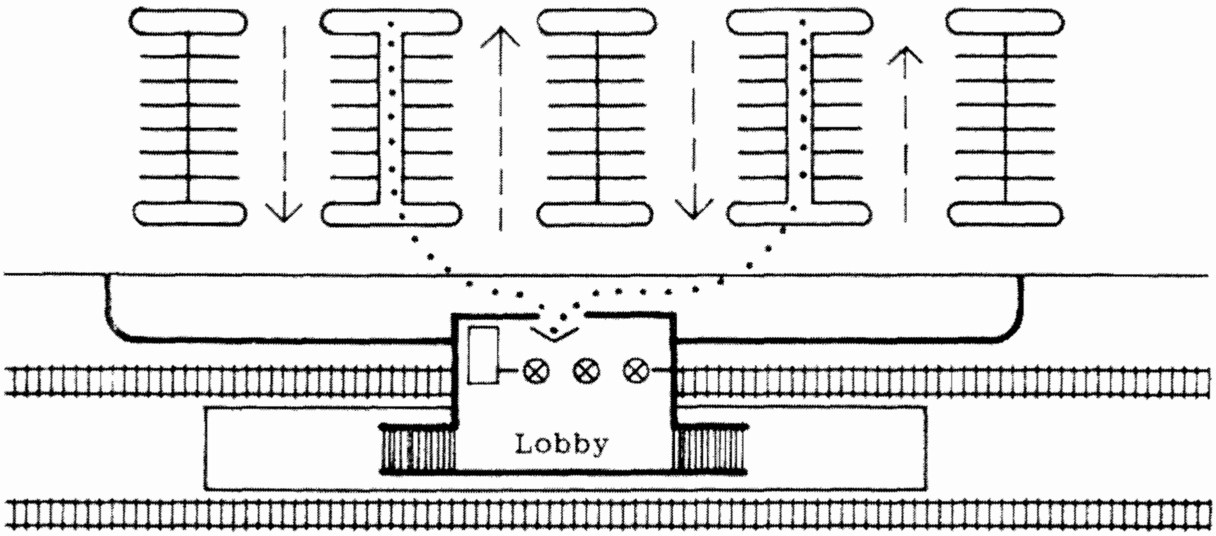
Parking lot exits may be shared with the other access modes. Several exits may be used as long as gates and signs are provided to prevent illegal entry, where lots handle pay parking. Exits should be planned so that cars waiting to enter the street do not foul other station traffic.

Street access to parking areas should be designed in keeping with good traffic engineering and geometric design practice. Street improvements, including signalization, widening, and construction of access roads or ramps, can be made when necessary.

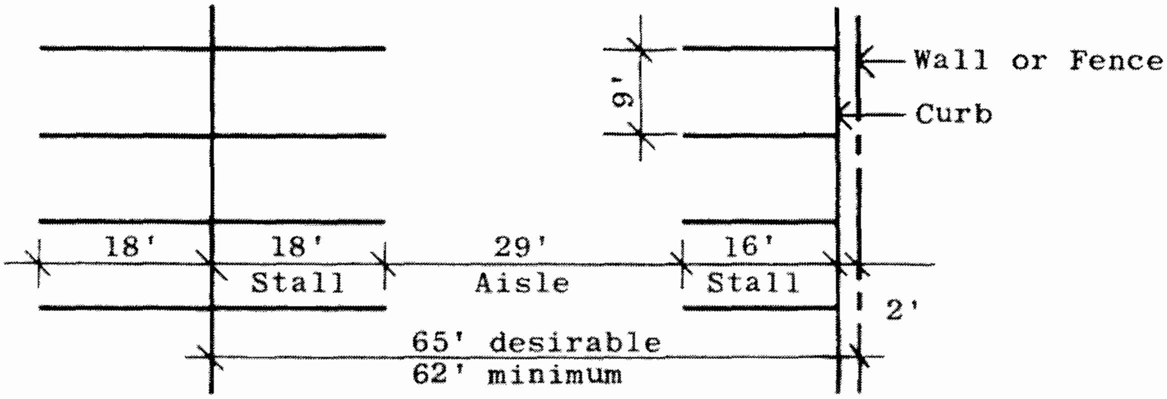
The ability to have paid parking must be designed into all new Park and Ride facilities, though installation of control devices may not be made initially. Roadways and control points should be located so that cars waiting to pay will not block either public street access or internal access routes to kiss-and-ride and bus terminal areas. The roadway at the control point should have at least two 10 ft. lanes, with at least six feet width at each shoulder for attendant's booths and automatic toll collection equipment. Storage space should be allowed for waiting cars, so that adjacent facilities will not be blocked.

A single entry control for Park and Ride lot where a fee is collected is usually preferred. The entry from the street may be shared with kiss-and-ride and bus traffic. Site considerations and traffic demand may require several entries in particular cases. It may be necessary to divide the parking into several individual lots each with its own control. This layout should only be used when there is no other solution.

PARK & RIDE FACILITIES - ACCESS AND CONTROL



Circulation within the parking bays should be one way, with a counter-clockwise pattern preferred. Entrys to bays and the roadway system should be well signed. Bays should be aimed toward the station entry so that pedestrians flow along the bays to the station. Crosswalks at busways should be marked.



Ninety degree parking is preferred with angle parking used only where space is restricted. The preferred dimensions for right-angle parking bays are shown above.

With a 65' bay width the stalls may be reduced to 8.5', or the stalls may be held at 9' and the aisle width reduced to 62' in tight situations. Minimum inside turning radius for cars is 20' with outside 30'. Other details of right angle and angle parking may be found in various handbooks.

PARK AND RIDE FACILITIES - LAYOUTS & DIMENSIONS

Parallel curb parking may be used in Kiss-and-Ride areas and in other left-over spaces. Stalls should be 9' wide and 22' long.

For preliminary planning purposes, assume 350 sq. ft. per parking space, which gives 125 cars per acre. This allows for stalls, aisles, and general circulation within the lot.

Curbs or barriers between stalls and bays should not be used, because they make efficient snow removal impossible. However, ends of bays may be defined with raised curbs. Where pedestrian flows through a lot are more concentrated, as in the case of pedestrian access way from outside the station, curb protected pedestrian ways should be provided, with allowance made for snow removal.

To break-up the scale of large lots, they should be sub-divided into sections. Changes in level, protected walkways, access roadways and landscaping may be used for this purpose. In general, where landscape elements are used they should be massed rather than scattered thinly throughout the lot. This yields a better visual effect, and easier snow removal and maintenance.

Landscaped barriers at least 10' wide should separate the parking area from adjacent streets. Special cases, particularly in residential areas, may require greater width. Vertical screens or fences may be needed to protect the privacy of neighboring parcels. Landscape spaces and materials must be designed with snow removal, minimum maintenance cost, and the vandalism threat constantly in mind.

Grassed areas require constant care and should be avoided if possible. For variety, various paving materials such as brick, stone, or concrete textures may be used . (See Part X-B3)

Lighting in general is discussed under environmental criteria in this section. Wires, wood poles, and other unsightly devices will not be permitted.

PARK & RIDE FACILITIES - LOT LAYOUT & LANDSCAPING

Parking garages will be used at a few specific locations where the parking demand exceeds the supply possible with surface parking alone. Garages, like lots, will have provision for entry control, and will be self-parking. Space criteria for stalls and aisles is similar to that of lots. Preferred grade of ramps is 5% with 10% as absolute maximum. Overall design should be in keeping with good self-parking garage planning practice. Pedestrian circulation within the garage should be designed to connect directly with the station lobby. Special controls to limit the use of the garage by non-transit riders other than at the entry may be necessary.

For further information refer to the following books:

Baker and Funaro, Parking, Reinhold, New York, 1958

Brierly, J., Parking of Motor Vehicles, C.R. Books, Ltd., London, 1962

Burrage, Robert, Parking, Highway Traffic Control Board, Saugatuck, Connecticut, 1957

PARK & RIDE FACILITIES - GARAGES

Facilities should be made available for "kiss-and-ride" and taxi passengers at all non-downtown stations. Unless otherwise specified, these facilities should rank second in access priority after buses. Space needs vary with time of day. Relatively little space is needed in the mornings for auto drop off, but in the evening rush more space for waiting cars is required. Both on and off-street "kiss-and-ride" facilities are possible.

On-Street Facilities:

Traffic patterns on adjacent streets and site considerations may dictate the placement of "kiss-and-ride" space on the street. Where possible a pull-out lane, similar to that shown for on-street bus terminals, should be provided. A free-standing shelter should be furnished at such locations if specified by the Authority. These areas should have easy pedestrian access to the station, and be placed so that waiting cars will not block bus or parking lot access ways.

Off-Street Facilities:

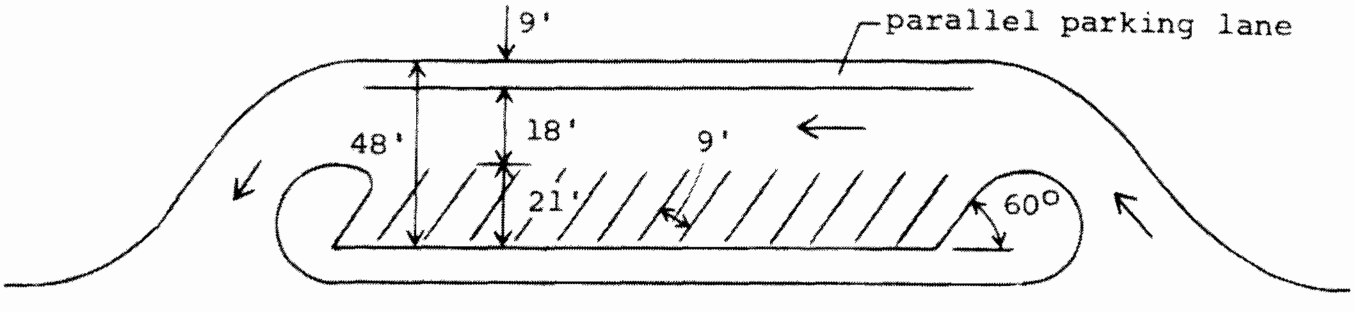
Off-street "kiss-and-ride" facilities should be used wherever space permits, and usually are provided at suburban type stations. The roadway for "kiss-and-ride" may be shared with buses at light traffic stations. The "kiss-and-ride" facility should be located so that it will not interfere with buses or other traffic. Pedestrian access to the station may cross busways at properly marked crosswalks, where bus traffic is not excessive. See parking lot geometry above for parking space criteria.

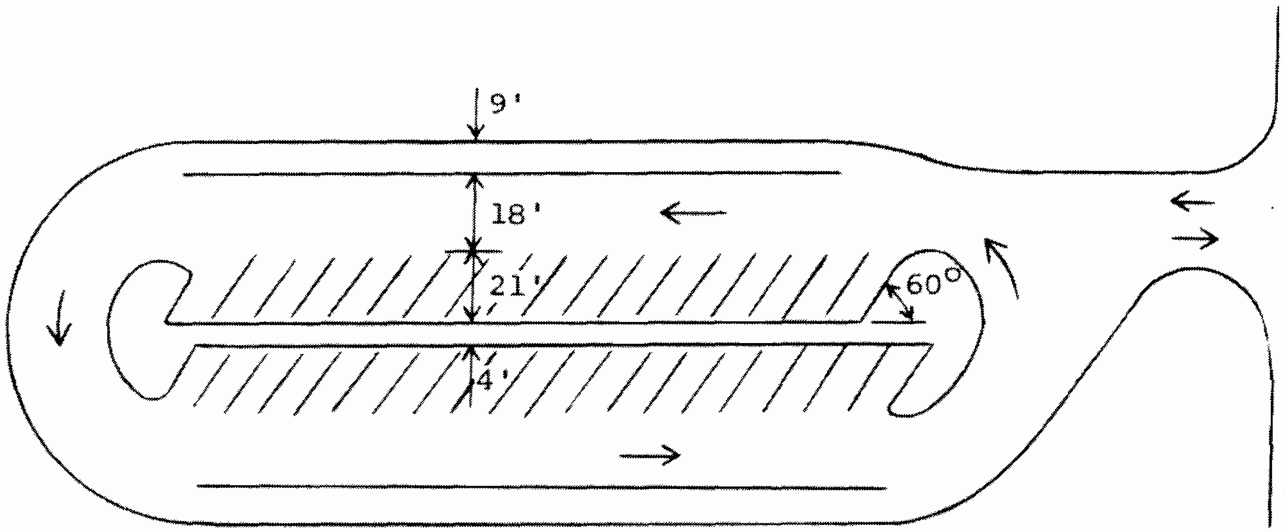
As park and ride lots may have controlled entrance or exit, the "kiss-and-ride" roadway must be placed so that cars may enter and leave without going through the parking lot control.

Parking space for 20 to 60 waiting cars is generally necessary though specific requirements will be given for each station. This space can be used for mid-day parking if properly controlled by parking lot personnel or meters. As an alternative, part of the park and ride lot may be used for waiting cars during the evening rush period, when the parking lot is not controlled.

Parking spaces within the kiss-and-ride area are normally layed out with a row of 60^{o} diagonal spaces on one side of an aisle, and parallel curb spaces on the other.
(See sketches)

KISS-AND-RIDE AND TAXI FACILITIES





Curve radii and roadway widths should be sufficient to permit operation of buses in the kiss-and-ride area if required.

KISS & RIDE - TYPICAL LAYOUTS

This section discusses briefly some of the other facilities or activities which must be accommodated within or adjacent to the station site. Specific details will be furnished by Planning or by the engineering department or consultant responsible for the particular item in question.

Power Substations:

Power substations are often associated with passenger stations. The preferred design of substations occupies a space approximately 50' x 70'. This is a rectangular box with a split level interior layout. The transformer bay occupies a lower level, at grade, along one long side, and has open side walls fenced or with grilles for ventilation. The building must have truck access along the transformer bay. Other layouts involving open air switchgear and transformers are possible. These however, occupy more space, and are less suitable for residential or commercially developed neighborhoods. The substations should be located away from prime space in the vicinity of the station lobby and bus terminal areas. Architecturally, they should be compatible with the passenger station and be visually friendly to their surrounding neighbors. In specific cases it may be possible to build the substation into a parking structure, or some other part of the station structure. Exterior design of substations should be developed in coordination with the station architects.

Relay Rooms, Signal Towers:

These facilities may be built into the station or platform structures, or be free-standing (see Service Facilities, Part IX). Built-in facilities are preferred for economy and to minimize the clutter at stations. Specific information is supplied by the engineering department and consultants responsible for train control, signals, and communications. These spaces or structures must be integrated into the total design by the station architect.

<u>ELECTRICAL FACILITIES</u>

Space should be made available wherever possible in heavily used new stations for concessions and shops. These facilities not only produce revenue; they also perform a public service and contribute substantially to the lively character of the stations as "places" integrated with their community.

Newsstands should be built-in to station lobbies, so as to minimize improvised cluttering from stands that are added after construction.

Other concessions such as small coffee shops, flower shops, bakeries, book shops and small clothing shops may be possible at the busier stations. These may occupy space or cubage that can be built at little extra cost over that needed for transportation purposes.

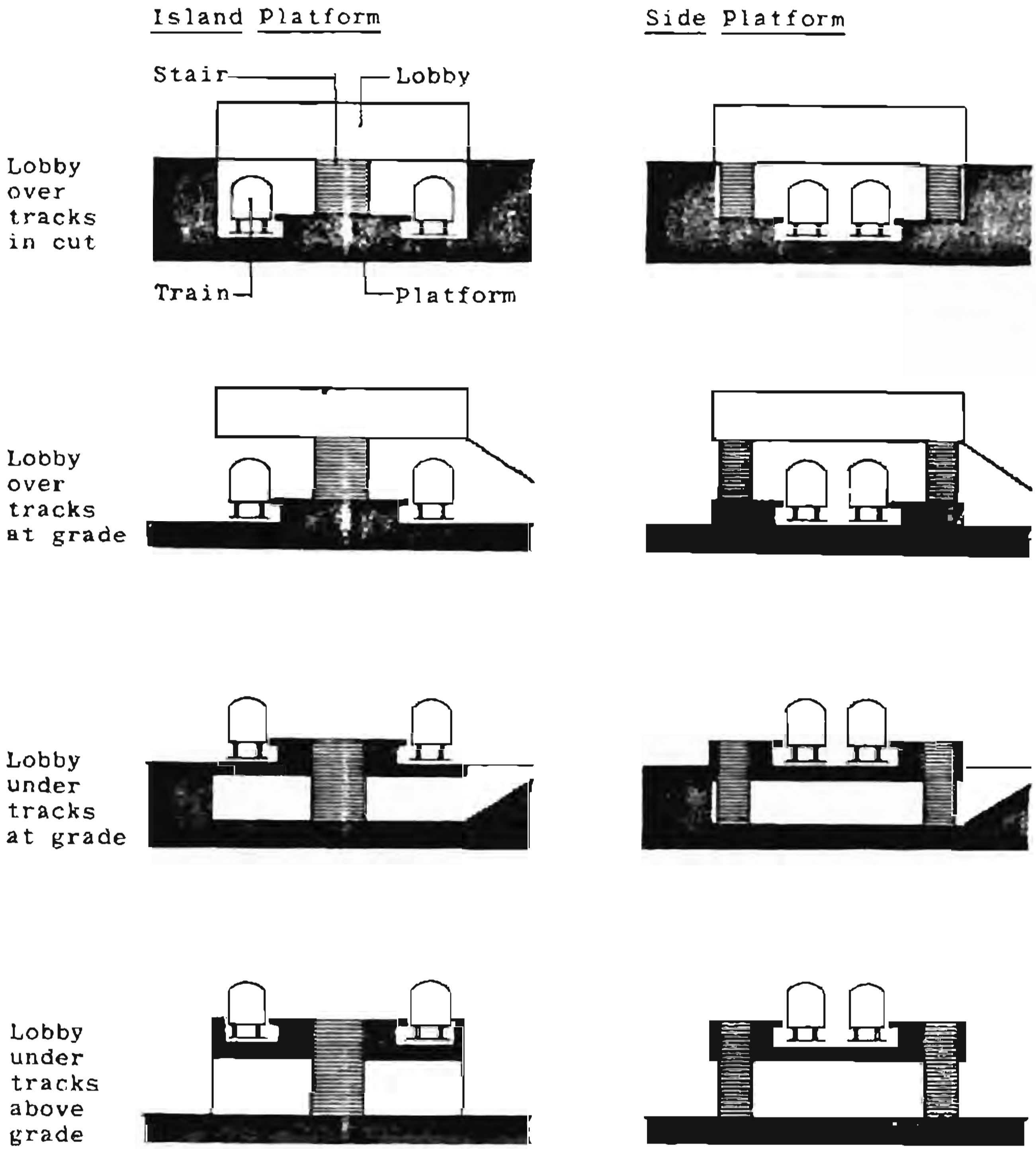
To be successful, space for concessions must be along the primary circulation routes (never in a cul-de-sac) but they must in no way interfere with the pedestrian flow that is passing by them.

CONCESSIONS AND SHOPS

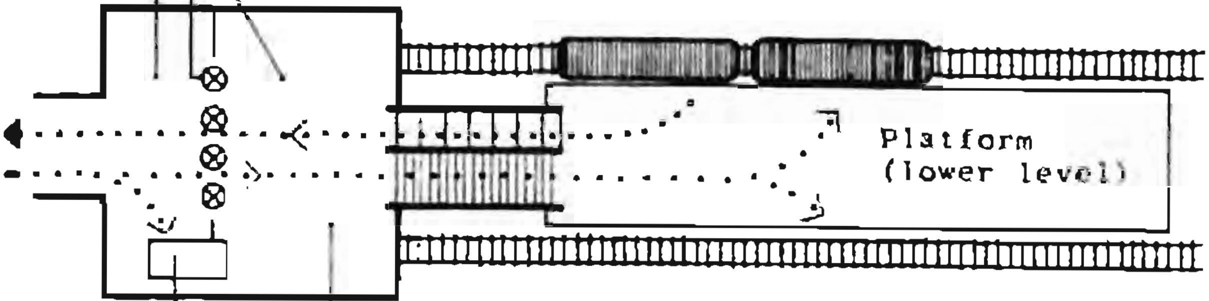
Station lobbies are located under, at, or over the platform level. Minimum vertical distance between platform and lobby is about 13' for a lobby over the tracks, and 14.5' for a lobby under the tracks, assuming minimum depth of structure. Where railroad freight tracks are parallel to, and at the same grade as, the transit line, a lobby over the tracks will have to be somewhat higher. Precise clearance for railroad facilities is spelled-out by the Authority.

In general, lobby facilities should not be at platform level. Fare collection facilities on an island platform require excessive platform width, and once installed are difficult to expand in case of an increase in traffic. At a side platform station, fare collection on the platform requires inefficient duplication of fare collection equipment, and manpower. Such a station layout may be convenient in one direction of travel, but often extremely inconvenient in the opposite direction. As a rule, stations and station lobbies should be laid out so that the station can be controlled by a minimum of one person. Stations with lobbies located at both ends may be designed so that a major lobby is open at all times, and a minor lobby is open part time as an entry and full or part time as an exit.

LOBBY/PLATFORM RELATIONSHIPS



STATION CROSS-SECTIONS



Lobby Layout

Details of lobby layout, fare collection, vertical circulation, signing, graphics, and service facilities are found in Parts IV, V, and IX of the Manual. Capacity requirements for design of lobbies and circulation are furnished by the Planning Department.

For preliminary layout purposes refer to the following exerpts from Part IV, "Components".

> Design Capacity of coin or token turnstiles, and exit gates: 40 persons/min.
>
> Turnstile Dimensions: 4' deep x 2'-4" wide (automated gate 3' wide).
>
> Exit Gate: 5'-6" diameter.
>
> Minimum queue space on each side of the turnstile bank:
> a) Suburban Station: 15'
> b) Downtown Station: 20'
>
> Total minimum depth of fare collection area excluding stair run-off and through circulation paths:
> a) Suburban Station: 34'
> b) Downtown Station: 44'
>
> Width of fare collection area depends on traffic.

Note that stations outside of the central area must be designed for collection of fares for persons entering and leaving the station. Allowance should be made at all stations for eventual uses of change machines, and ticket machines which could be incorporated in a future automated fare collection system.

TYPICAL STATION CIRCULATION

The long-range goal of the Authority is to provide sufficient escalators at each station so that there will be available to any passenger at least one path between vehicle and surface, or from vehicle to vehicle at transfer points, where all upward movements of over ten feet are mechanized, provided average daily volume at such points is at least 1000 potential passengers.

Wherever a continuous downward movement exceeds 25 feet, the use of a down escalator should be considered, especially if such escalator would lend itself to reverse operation when traffic flow peaks in the opposite direction.

The term "escalator" as used here, may also apply to "moving ramps" or "moving sidewalks" where appropriate. Moving sidewalks should also be considered in cases of long horizontal transfers with heavy traffic.

All new stations should be designed to meet the above goals as nearly as possible, consistent with the funds available, even if actual installation of the escalator is deferred to a later date.

Summary of Planning Standards for Vertical Circulation

1) Stairways:

Maximum Capacity: 20 persons/foot-width/minute,(or 36.5 persons per minute for each single lane 1'-10" in width.)

Design capacity: 15 persons/foot-width/minute.

Minimum Width: 6' which allows for later installation of escalators and stairs - wider than 8' requires a center handrail.

Approximate Length: 1.73 x rise (for 30 stair used in conjunction with escalators) plus landings @ 4.5' for straight stairs with a rise of 8' (15 risers) or over. Landing for return stair should equal width of stair.

Minimum Run-off: (clear space) at ends of stair or escalator:
- a) To a solid obstruction: width x 1.7
- b) To edge of queue space: 10'
- c) To another stair or escalator: 30'

Note: Run-off for stair and escalator in same well is the combined width x 1.7.

VERTICAL CIRCULATION

2) Ramps:

Design Capacity: Minimum width and run-off same as stairs.

Maximum Slope: 1:12, preferred 1:15.

3) Level Passageways:

Design Capacity: Range from 20 to 25 persons/foot-width/minimum.

Minimum Width: 10', preferred 12'

4) Escalator:

Maximum Capacity: 135 persons/minute for a 4' tread width and speed of 120'/minute (32" escalators not to be used in new work). For design capacity, use 100 persons/minute.

Width: 6' clear shaftway opening.

Approximate Length: 1.73 x rise + 15' (30° slope plus level transition at ends). See manufacturers catalogues for precise dimensions.

Minimum Run-off (clear space at ends):

a) To a solid obstruction: 15'
b) To edge of queue space: 10'
c) To another escalator or stair: 30'

Note: Moving sidewalks have similar characteristics except that maximum slope is 15° (1:3.46)

Minimum headroom requirements for all pedestrian passageways, stairs, etc. is 7'-6" for short distances (under beams, etc.), preferred minimum 8' to 10'. For greater detail, see Section IV, Components.

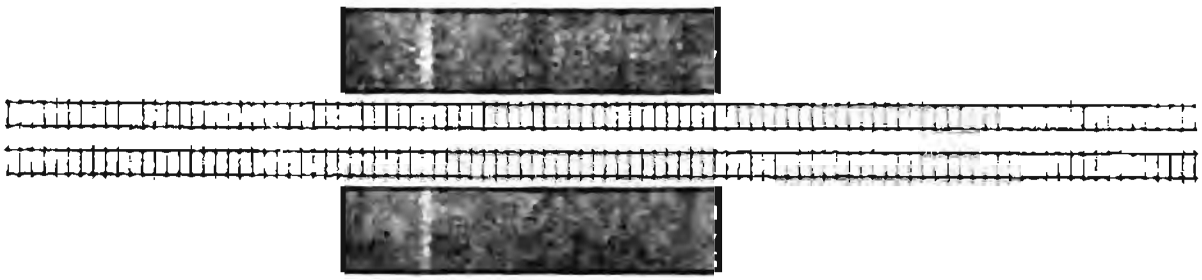
5) Elevators:

May be required at selected locations for use of handicapped, and in multi-story parking garages

Minimum cab size: 4' x 4' clear

VERTICAL CIRCULATION

"ISLAND" PLATFORM, OR "CENTER" PLATFORM

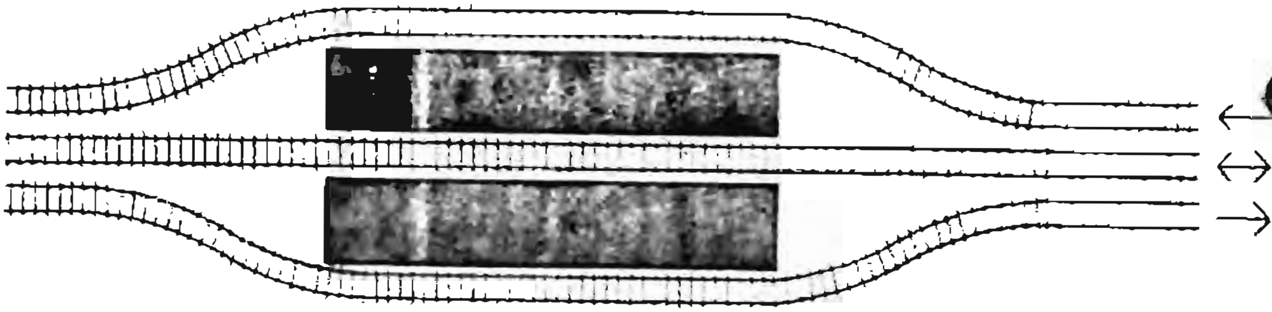


"SIDE" PLATFORM, OR "DIVIDED" PLATFORM

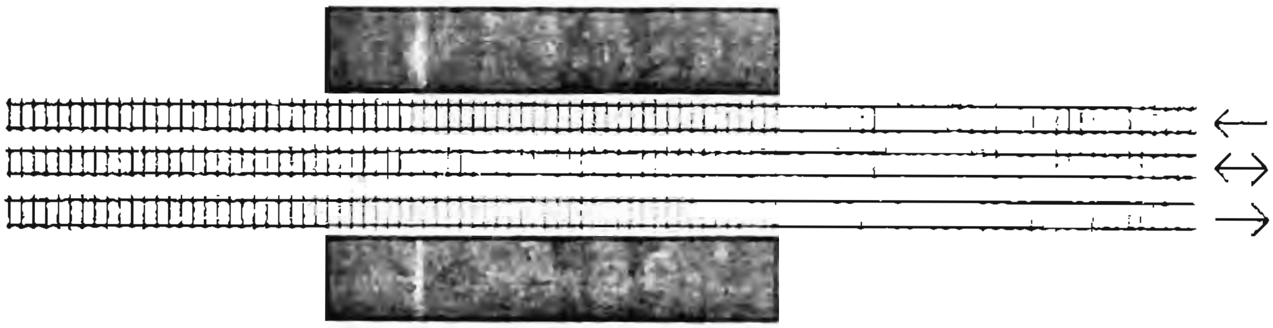
Stations on two-track lines are of two types: island platform and side platform. Island platforms are preferred because they offer more efficient use of platform space, furnishings, and vertical circulation. Traffic flow at the typical station, outside of downtown, is very peaked -- A.M. inbound, P.M. outbound. Island platforms result in a more efficient lobby layout with a cleaner straight-through circulation path than is possible with side platforms. The passenger need not make his decision as to train direction until he reaches the platform instead of in the lobby where space is more restricted and other activities, such as fare collection, must occur.

However, in certain areas physical conditions at or near the station site will have a strong constraint upon the track alignment and require the use of side platforms. In special cases, of a particularly heavy interchange movement, a side platform layout could be required to permit easy cross-platform transfer to buses. Platform configurations are specified by the Authority.

PLATFORM TYPES: TWO-TRACK



DOUBLE ISLAND PLATFORM



SIDE PLATFORM

Stations on three-track lines are of two general types: double island and side platform. The double island type is preferred as it offers the greatest flexibility for operation. Trains on any track can stop at the station if necessary and any track may be used as the express track. As in the case of two-track routes, side platforms may be necessary at certain locations. An advantage here of side platforms is that less overall width is needed than for a double island layout.

PLATFORM TYPES: THREE-TRACK

Variation of platform access points along a route

Platforms may be center loaded or end loaded - at one or both ends. End loading requires less platform width and offers more straightforward circulation than center loading, while the latter shortens walking distance on the platforms. As people who enter a station to await a train will tend to cluster in the vicinity of the platform access point, it is necessary to vary the points of access from station to station along a route. One station should be center loaded, another at the inbound end, another at the outbound end and perhaps another double end loaded. Loading at the third or quarter points is also possible. Thus, boarding passengers will be distributed more or less uniformly along the length of a train as it proceeds along its route.

The approximate location of platform access points are normally specified by the Authority.

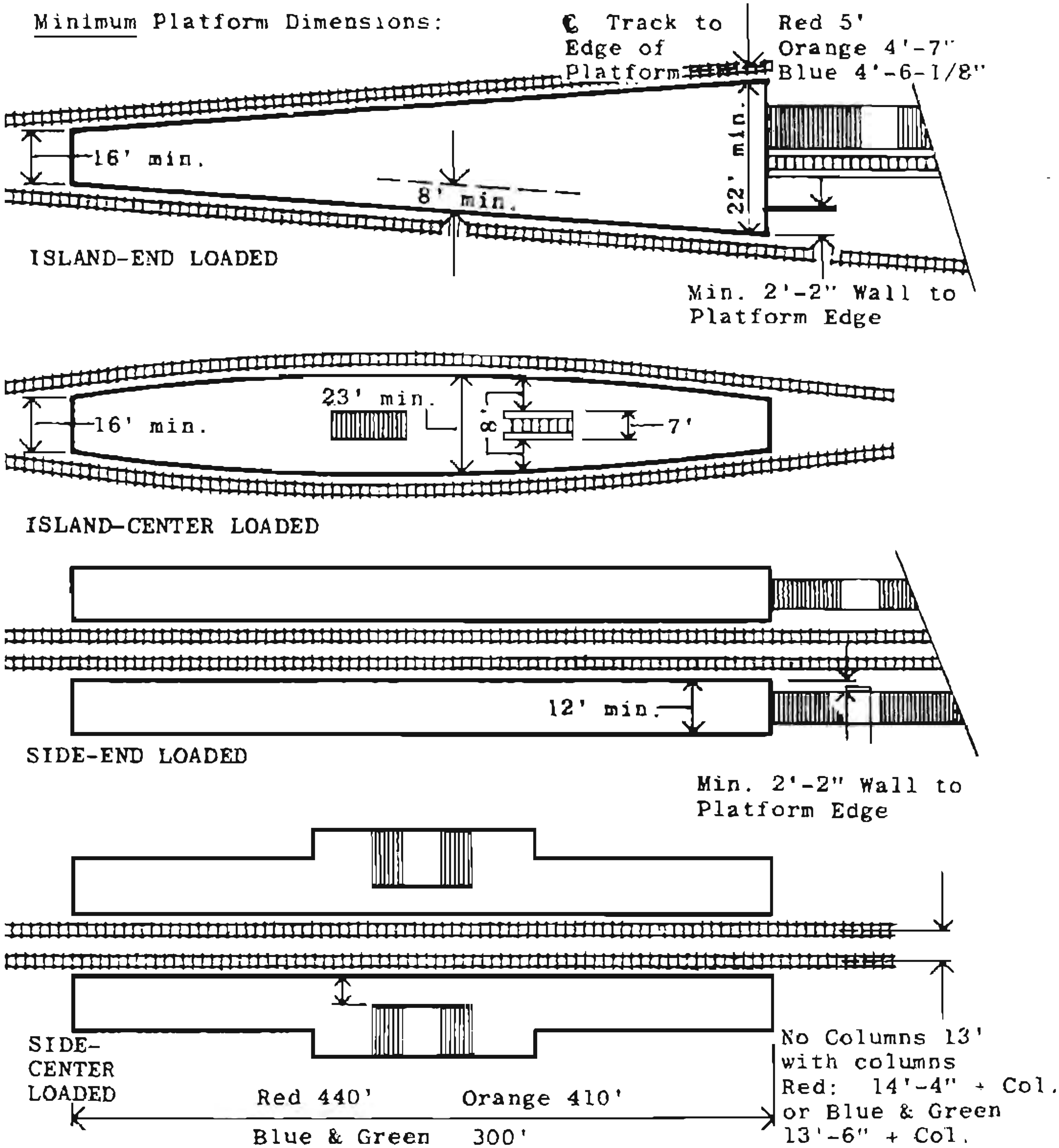
PLATFORM ACCESS

Platforms should be on tangent tracks, and on grades of ½% or less, if possible. When curves are necessary, the radius should be at least 4000'-5000'; and platform faces should be convex curves. Concave curved platforms should be avoided because they make it difficult for train guards to have clear sightlines along the train when closing doors. Platforms may be tapered at the ends with long radius convex curves to permit maximum width at the access point while permitting the tracks to reach normal spacing within a reasonable distance from the station.

Minimum headroom requirements is 15' from top of rail to any structure over the tracks, though a lower ceiling over the platform is permissible with 9'-6" from platform to ceiling as minimum. (This allows 1'-0" depth for continuous lighting fixture located above the platform edge.) The edge of the dropped ceiling should be set back at least 2'-2" from the platform edge.

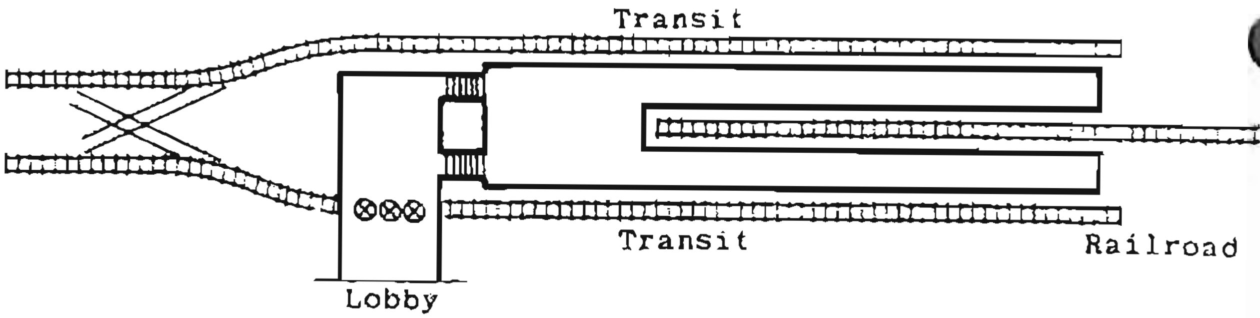
Other details of platform widths, lengths and clearances are found in Manual Parts I and IV.

PLATFORM - DESIGN CRITERIA



Note: All clearances to be checked with the Authority and/or track geometry consultants.

PLATFORM DIMENSIONS



Railroad shuttle service connecting with several rapid transit stations is currently under study. Preliminary design of these particular stations must allow for this kind of service. What facilities are actually built will depend upon the outcome of these studies.

Ideally the station should be planned to permit future conversion of the railroad facilities to electrified rapid transit, with through service to downtown. If possible, cross-platform transfer should be planned. A possible layout for such a terminal is shown above.

RAILROAD SHUTTLE TRANSFER

MASSACHUSETTS
BAY
TRANSPORTATION
AUTHORITY

GUIDELINES AND STANDARDS
PART XI
VENTILATION
REVISED 1977

MANUAL OF GUIDELINES AND STANDARDS

GENERAL INTRODUCTION

The Massachusetts Bay Transportation Authority has found it both necessary and possible to concentrate attention on the complex needs of people. Programs to improve service must now include a new emphasis on the quality of the transportation experience. In effect, transportation engineering has been joined by human engineering and environmental design.

This manual provides a framework for the continued coordination of all those elements in the system that affect human comfort.

Many of the criteria involved are common to all environments, such as the control of light, noise, humidity, temperature, wind, and odors, or the need for orderliness, through clear and easy circulation and clean appearance. Other criteria that are more specific to the transportation environment are such needs as safety, traffic handling capability, spatial variety, consistently available information, and orientation.

The most important single criterion that has guided the preparation of this manual is the need for orientation. The rider must not only be physically comfortable, he must also know in the fullest sense where he is and where he is going.

Since to the layman a public transportation system is to a large extent an invisible skeleton of the city and metropolitan region, the comprehension of that structure generates an awareness and appreciation of the city itself, and an appreciation of travel through it.

There are many aspects to achieving this orientation. Circulation at all points must be direct and open. Spaces should relate visually to their surrounding environment, either through direct openings to adjacent spaces and structures, or in the case of platforms, by graphic reflection through photographic murals.

Above all, the need for orientation places great emphasis on maps and a consistent system of identification and directional signing. Graphics then emerges as a major factor in the design of each environment, a factor that must be given high priority in the early design phases of each project.

It is hoped that all participants in all programs will familiarize themselves with the entire manual, so that the implications of each decision can be understood in a system-wide context.

The standards and guidelines presented here are not inflexible rules. They are a framework for meaningful development and variety, and offer no restriction to the capacity of each participant to evolve better solutions to old or new problems.

As new solutions are developed and approved, revised and additional pages for the manual will be issued to all participants.

PART XI - VENTILATION

A. Ventilation Standards for Stations

1. General Information
   Method of Ventilation

2. Special Heat Sources in a Subway Station
   Special Requirement
   Normal Ventilation of a Typical Subway Station

3. Normal Ventilation in a Station Inside of Which
   Diesel Powered Buses Operate

4. Emergency Ventilation
   Controls

B. Subway Environmental Design Handbook

1. Outline of Handbook

C. Detailed Criteria

(Revision of 1977)

PART XI SERVICE FACILITIES

A. VENTILATION STANDARD FOR STATIONS

The primary requirement of a station ventilation system shall be to provide a safe environment for the Authority's passengers. It shall have the capability in an emergency to exhaust smoke fumes, etc.

A secondary requirement of a station ventilation system shall be making the environment within the station, under normal operating conditions, conform to certain standards for the comfort of our passengers and employees.

1. General Information

a. The rapid transit trains operating between Quincy and Harvard Station are air conditioned.

b. All new rapid transit and light rail (similar to streetcars) will be air conditioned.

c. Existing cars will not be air conditioned.

d. Existing stations will not be air conditioned.

e. Previous to this time, normal subway and station ventilation has been accomplished by the "piston action" of the trains. The rolling stock push the air in the subway ahead of it to the next vent shaft emergency exit connection to the adjacent subway or station. When the train passes an exit for the air, it draws air along after it.

f. Electric motor driven fans are provided at various locations in the transit system for emergency ventilation. While not decided at this time, the Authority may order the operation of certain of the fans at night to bring cool air into the subway to cool the subway walls and lower the general subway temperature.

2. Method of Ventilation

a. In general, ventilating air will be drawn or pushed into the station from the subway.

b. Air will be exhausted from the station to the outside.

c. The consultant shall evaluate the effect of the existing vents, emergency exits and any new ventilation under study by others or being installed.

3. Special Heat Sources in a Subway Station

In addition to the normal heat in a subway station, lights, etc., a major source of BTU's is the trains. The braking and accelerating of a train, the heat output of the auxiliaries and heat of the sun on the cars while running outside the tunnel add many BTU's to the station.

4. Special Requirements

Realizing the limitations of the existing subway stations, it is still desired that the consultant design a system that will limit the amount of dirt laden air from entering the station. Any duct work carrying air from the subway to other parts of the station will be equipped with easily serviced filters in the line. Unless the filters are easily serviced using hand carried tools, they will soon become overloaded and useless.

5. Normal Ventilation of a Typical Subway Station

a. Any individual rooms in a station shall have a system with the capabilities as listed below:

Cable Rooms and Pits	Natural ventilation to suit heat load
Electrical Operating Equipment Rooms - Control Rooms	8 changes of air per hour (even outside air must be filtered)
Maintenance and other Personal Rooms except Toilets	8 changes of air per hour
Toilets	10 changes of air per hour
Battery Rooms	15 changes per hour

The consultant shall balance the cost of using filtered subway air including special controls such as remote controlled louvers necessary in case of fires in the subway against the cost or providing an outside air supply.

b. The station ventilating equipment shall be capable of maintaining the ambient temperature in the station within 5° of the ouside air when the temperature is 91° F and 10° F when the outside air is 60° F. Further, the system shall have the capability of supplying 7.5 cubic feet of fresh air per minute for each passenger in the station complex.

6. Normal Ventilation in a Station Inside of Which Diesel Powered Buses Operate

The consultant shall research the existing state of the art of diesel fume removal. In general, an attempt will be made to have an exhaust grille located 5' forward of the left rear of a bus in its normal berthing position. Where there are two bus lanes, an intake air grille shall be located opposite the exhaust grille.

The normal flow of exhaust from a diesel bus when accelerating is estimated to be 500 SCFM. Unless the state of the art research shows that this figure is improper, the consultant shall provide an exhaust capacity of 12 x 500 or 6000 SCFM per berthing position. The velocity through the grille will be at least 1000 feet per minute and not greater than 1200 feet per minute. Where there are two lanes, the intake grille will have a capacity of 5000 SCFM.

The consultant shall make a comparison of the most economical system considering the number of buses berthed during the rush hour and the number at other times. During the rush hour, all systems could be operated; at other times fans could be shut down.

Proper consideration shall be given to the exterior ends of the intake and exhaust systems so that there will not be any "short circuiting". The air drawn in shall be as uncontaminated as possible and the vitiated air shall be properly discharged.

Further, special care shall be taken so that any air fouled by diesel fumes is not blown into the subway.

Normally, if vehicles enter and leave a station, it is open enough so that additional ventilation beyond the above is not required. In any case, Section 5 above must be satisfied either with mechanical fans or natural ventilation.

7. <u>Emergency Ventilation</u>

The ventilation system shall have the capability of exhausting the air in the station complex 15 times per hour. The emergency ventilation system shall include station fans and may include fans located in the subway between stations.

Where possible, provision shall be included to close off, by dampers, individual rooms to accomplish the above.

8. <u>Controls</u>

Fan controls for normal operation shall be located at a convenient place in the station.

Emergency controls for station ventilating equipment shall be located both in the station and at the Dewey Control Center. Controls for ventilating equipment located in the subway shall be located on the adjacent subway platform and the Dewey Control Center.

Controls shall be able to reverse fan motors.

Each control area will be equipped with indicating lights to show the operating status of the equipment.

B. SUBWAY ENVIRONMENTAL DESIGN HANDBOOK

This technical report, Project No. DC-06-0010, funded by UMTA, has been prepared for planners, operators, and others involved with underground rapid transit systems who are not necessarily concerned specifically with environmental control but who require guidelines for this decision-making process in the overall system design. The following is a brief outline that illustrates areas covered.

It is hoped that if more specific information is needed the "Handbook" will be referred to.

There are also a number of Appendices that detail research reports, scale models, survey results, bibliography and statistical information on eleven Canadian and United States subway systems relative to environmental control. Furthermore, there is a Volume II of the "Handbook" that contains detailed computer programs and other aids to the designer.

HEATING, VENTILATING, AIR CONDITIONING REQUIREMENTS FOR STATION AREAS

The following criteria supplement the information shown on pages 1 through B1.1 issued in 1974. In case of conflict, these new criteria will apply:

1. LOBBY AND FARE COLLECTION (Below Grade)

Temperature:	No control. Provide exterior finishes and equipment capable of withstanding temperature variations ranging from 0° F to 105° F.
Humidity:	No control.
Ventilation:	Provide sufficient outside air in summer months to carry heat gain with a maximum differential of 10° F. All ventilation shall be mechanical. Turn on summer ventilation by thermostat set at 80° F inside temperature. Design for residual velocities of 50 FPM.
Odor:	No control.
Dust:	Throw away filters with indication of pressure drop across filter.

2. COLLECTOR'S BOOTHS

Temperature:	Maintain 70° F minimum in winter months. Maintain 78° F maximum in summer months. Consider using water-cooled condensers below grade if practical and air cooled condensers above grade if good ventilation is available. Energy source to be electricity.
Humidity:	No control.
Ventilation:	Provide 20 to 25 CFM local outside air. Maximum residual air velocity in occupied area to be 50 FPM. All ventilation shall be mechanical and run when booth is occupied.

Odor: No control.

Dust: Throw away filters.

3. PORTER'S ROOM

Temperature: Maintain 45° F minimum in winter time. No control in summer time. Electric heat. Thermostat control. Capacity adequate to heat ventilation air.

Humidity: No control.

Ventilation: Provide 1/3 CFM local air per square foot of floor area. 100 CFM minimum. Maintain small negative pressure in room. Exhaust to outside. Mechanical ventilation on-off switch.

Odor: Negative room pressure.

Dust: No control.

4. SAFE ROOM

Temperature: Same as 3.

Humidity: Install dewpoint control to prevent wall condensation in intermediate seasons. Humidistat and two thermostats.

Ventilation: Provide 1/3 CFM per square foot floor area, local air. 100 CFM minimum. Maintain small negative pressure in room. Mechanical ventilation. On-off switch.

Odor: No control.

Dust: No control.

5. ELECTRIC CLOSET

Temperature: Same as 3.

Humidity: Same as 4.

Ventilation: Provide 1/3 CFM per square foot floor space local air 100 CMF minimum. Main-

Ventilation (cont'd.)	tain small positive pressure in room. Mechanical ventilation. On-off switch.
Odor:	No control.
Dust:	Provide 30 to 35 percent efficiency filter based on ASHRE 52-68 test. Maximum velocity through filter 200 FPM. Initial pressure drop. 12 inches water guage. Provide indication of filter pressure drop. Change filter when pressure drop reaches 7 inches water guage.

6. PUBLIC TOILETS

Temperature:	Maintain 45^{o} F minimum in winter months. No control in summer months. Locate to minimize heating requirement. Electric heat. Thermostat. Adequate to heat ventilation air.
Humidity:	No control.
Ventilation:	Provide 40 CFM for each toilet and 40 CFM for each urinal, but not less than 50 CFM in any single toilet. Use local air and exhaust to outside. Maintain small negative pressure in room. Mechanical ventilation. On-off with light switch.
Odor:	Negative room pressure.
Dust:	No control.

7. EMPLOYEE TOILETS

Temperature:	Maintain 70^{o} F minimum in winter time. Electric heat. Thermostat. Capacity adequate to heat ventilation air.
Humidity:	No control.
Ventilation:	Same as 6.
Odor:	Negative room pressure.
Dust:	No control.

8. LAMP STORAGE

Temperature: Same as 3.

Humidity: Same as 4.

Ventilation: Provide 1/3 CFM per square foot floor space local 100 CFM minimum. Maintain small negative pressure in room. Mechanical ventilation. Of-off switch.

Odor: Negative room pressure.

Dust: No control.

9. HEAD HOUSES

Temperature: Maintain heated entrance to control ice.

Humidity: No control.

Ventilation: None.

Odor: No control.

Dust: No control.

10. MECHANICAL ROOMS (Underground)

Temperature: Same as 3.

Humidity: Same as 4.

Ventilation: Same as 5.

Odor: No control.

Dust: Same as 5.

11. MECHANICAL ROOMS ABOVE GRADE

Temperature: Same as 3.

Humidity: Same as 4.

Ventilation: Provide mechanical ventilation capable of carrying heat gain in summer with a 10° F differential. Provide 1/3 CFM per square foot in winter or 100

Ventilation (cont'd.)	CFM minimum. Outside air if practical. Maintain small positive pressure in room. Automatic control.
Odor:	No control.
Dust:	Same as 5.

12. <u>STORAGE ROOM</u>

Temperature:	No control.
Humidity:	No control.
Ventilation:	Provide 1/3 CFM per square foot of floor area minimum 100 CFM local air exhaust to outside. On-off switch. Maintain small negative pressure in room. Mechanical ventilation.
Odor:	Negative pressure.
Dust:	No control.

13. <u>BUS STARTER'S ROOM</u>

Temperature:	Same as 2.
Humidity:	Same as 2.
Ventilation:	Same as 2.
Odor:	Same as 2.
Dust:	Same as 2.

14. <u>PASSENGER WAITING ENCLOSED ABOVE GRADE</u>

Temperature:	Maintain 45° F minimum in winter. Electric heat. Thermostat control.
Humidity:	No control.
Ventilation:	Same as 1.
Odor:	Same as 1.
Dust:	Same as 1.

15. PASSENGER WAITING OPEN WINDBREAK TYPE

Temperature:	Provide radiant heat, electric, thermostat control.
Humidity:	No control.
Ventilation:	No control.
Odor:	No control.
Dust:	No control.

16. TRAIN PLATFORM

Temperature:	Same as 1.
Humidity:	No control.
Ventilation:	Provide exhaust system and supply air system capable of removing 60 percent of heat released from train dynamic braking grids while in station. Supply air and exhaust air quantities shall be directed over the platform to provide some air movement on the platform for people standing there. Automatically shut down supply air when outside air temperatures would be uncomfortable across platform. Continue to run exhaust system until heat is needed on platform at which time exhaust system shall be shut down. Exhaust system shall be part of emergency ventilation for station and shall be arranged for eventual remote control. Fans shall be capable of handling 300° F gases for at least one hour. Direct driven, single speed.
Odor:	No control.
Dust:	Same as 1.

17. INSPECTOR'S ROOM

Temperature:	Same as 2.
Humidity:	Same as 2.

Ventilation: Same as 2.

Odor: Same as 2.

Dust: Same as 2.

18. SIGNAL BUNGALOW OR ROOMS

Temperature: Maintain 78° F maximum in summer and 70° F minimum in winter. Electric resistance heat, direct expansion air cooling. Consider air cooled condensers, well ventilated above grade or below grade if practical. Water cooled condensers can be considered using city water and run to drain if three tons or smaller.

Humidity: 50 percent maximum in summer and intermediate seasons use electric reheat. No control below 50 percent.

Ventilation: Provide sufficient local outside air to maintain small positive pressure in room.

Odor: No control.

Dust: Same as 5.

19. TRAIN CREW LOBBY AND YARD CREW LOBBY

Temperature: Same as 2.

Humidity: Same as 2.

Ventilation: Provide 15 CFM per occupant as an average occupancy basis of local outside air where practical. Maintain small positive pressure in space.

Odor: No control.

Dust: Throw away filters with remote indication of pressure drop across filters.

20. SUBSTATIONS, RECTIFIER ROOMS, SWITCHGEAR ROOMS

Temperature: Maintain, minimum 45° F in winter time.

Humidity: Same as 4.

Ventilation: Provide sufficient mechanical ventilation to carry design day heat gain with a 10° F rise. Operate ventilation system automatically when inside temperature rises above 90° F.

Odor: No control.

Dust: Same as 5.

21. PARKING GARAGE

Temperature: No control.

Humidity: No control.

Ventilation: Provide sufficient ventilation to keep CO within safe limits. Operate mechanical ventilation if required by a CO monitoring system. Provide sound treatment on fan to limit noise level to that of surrounding area.

Odor: No control.

Dust: No control.

22. TOLL COLLECTION

Same as 2.

23. GARAGE OPERATOR'S OFFICE

Same as 19.

GENERAL HVAC GUIDELINES FOR BUILDINGS

1. Buildings with more than 25 tons of refrigeration shall use multiple compressor package water chillers installed in interior mechanical rooms with remote air cooled condensers.

2. Buildings with less than 25 tonw of refrigeration shall use direct expansion package-type equipment with remote air cooled condensers. Small room-type equipment may be used for offices and other small room areas where comfort, zoning, and economy are better served by this type of equipment.

3. All air conditioned buildings shall be zoned for comfortable and economical operation.

4. Buildings shall use hot water heating systems. Buildings with a chilled water cooling system shall use a four-pipe heating and cooling system. The heating requirement of wall and window shall be carried by a perimeter heating system. Roof and outside air heating requirement shall be carried by air handling equipment. Outside air tempering coils shall be equipped with separate run-around pumps, and the circulating fluid shall be glycol water solution.

5. Heat gains shall be calculated in accordance with storage system developed by Carrier Corp. Humidity control in comfort air conditioned areas shall be a function of a 5° F temperature swing above thermostat setting during the duration of the design outside temperature. Process humidity control shall be accomplished by refrigeration with reheat where necessary.

6. 10 CFM of outside air shall be supplied for every individual in the building in addition to exhaust required for toilets, etc. Outside air shall be controlled relative to building occupancy and shall be shut down when the building is unoccupied and shall be reduced under partial occupancy conditions. Enough outside air shall be supplied to maintain a small positive pressure in the building. All outside air shall be filtered and return air shall be filtered. Pressure drop across filters shall be remotely indicated at thermostat control locations. Instructions relative to filter maintenance shall be posted at the remote pressure drop readout.

7. Conference room air conditioning systems shall be completely independent of building air conditioning systems. Outside air in the amount of 30 CFM per chair shall be supplied. The heat gain shall be calculated on an instantaneous load basis. Conference room air conditioning shall be shut down when the room is not in use, and its unoccupied load shall be assumed by the zone it is located in.

8. All control systems shall be simple in nature. On-off control shall be employed everywhere possible. Conditions in occupied areas shall not be controlled by turning fans on and off. Electric controls are preferred, rather than electronic or pneumatic controls.

9. Heat trace all water and drain lines subjected to below freezing temperatures

FOURTH DRAFT August 21, 1981

FIRE PROTECTION AND LIFE SAFETY PROGRAM FOR THE MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

ARTICLE 1 - INTRODUCTION

The purpose of this document is to present the fire protection and life safety criteria for the design, construction and operation of the fixed guideway rapid transit system of the Massachusetts Bay Transportation Authority, hereinafter referred to as the MBTA, to provide a safe environment for the MBTA passengers, employees, property and equipment as well as the general public.

SECTION 100.0 SCOPE

This document describes the fire protection systems and life safety requirements for all new construction of rapid transit stations, tunnels and aerial structures.
It is divided as follows:

ARTICLE 1 - INTRODUCTION
ARTICLE 2 - FIRE ALARM AND WARNING SYSTEM
ARTICLE 3 - COMMUNICATIONS
ARTICLE 4 - VENTILATION
ARTICLE 5 - ELECTRICAL
ARTICLE 6 - CONSTRUCTION
ARTICLE 7 - MEANS OF EGRESS
ARTICLE 8 - FIRE FIGHTING FACILITIES
ARTICLE 9 - EMERGENCY PROCEDURES, INSTRUCTIONS AND EQUIPMENT

100.1 RAPID TRANSIT FACILITIES: All structures or parts thereof shall be classified in the rapid transit facilities group which are used or designed as rapid transit stations, including underground and above ground stations, tunnels, aerial structures, power plants and/or substations.

100.1.1 Included in this group are commuter rail stations which are in common with rapid transit facilities.

100.1.2 Excluded from this group are surface streetcar (light rail) stops and commuter rail stations with open platform areas which provide unlimited egress to adjacent open areas such as lawns, parking lots, roadways, and median strips. Also excluded are parking garages which are in common with rapid transit facilities.

SECTION 101.0 ADMINISTRATION AND ENFORCEMENT

101.1 BASIC CODE: All of the provisions of the Commonwealth of Massachusetts State Building Code, hereinafter referred to as the Basic Code, shall apply unless otherwise specifically modified herein.

101.1.1 Other Codes: All of the provisions of the Rules and Regulations of the Architectural Barriers Board and other applicable Massachusetts Rules and Regulations and General Laws shall apply.

101.2 JURISDICTION: All of the administration and enforcement of the Basic Code and of this rapid transit facilities code shall be under the jurisdiction of the Department of

Public Safety of the Commonwealth of Massachusetts, the State Building Code Commission and other applicable state agencies and local fire departments.

101.3 SPECIAL PROCEDURES: Required signatures of authorized MBTA officials must be obtained before plans and specifications may be issued for construction.

101.4 UPDATING: This document shall be updated as necessary to incorporate changes indicated by new technology, operating experience and improvements in the state-of-the-art of rapid transit transportation systems. Reference to the Basic Code shall include the latest amendments and shall refer to the latest edition.

SECTION 102.0 DEFINITIONS

The terms defined herein are in addition to those included in Section 201.0 (General Definitions) of the Basic Code.

Aerial Structure: Any system structure which carries transit tracks and spans above land or water surfaces. Also called an elevated structure.

Ancillary Spaces: The non-public areas or spaces of the stations which contain operating, maintenance or support equipment and functions.

Central Control: The location where train control or train supervision is accomplished for the entire rapid transit system; the system command center.

Communications Systems: Those elements and their interconnections which permit voice, data or video interchange of information between system functions which are separated by distance.

Contact Rail: A rail mounted on insulators alongside the running rail which provides traction power for train operation. Also called the third rail.

Station: A place designated for the purpose of loading and unloading transit passengers.

Station, Above Ground: A station in which the tracks and platform are either located on an aerial structure or rest directly on grade.

Station, Depressed: A station in which the trainway and platform areas are below the level of the adjacent finished grade.

Station, Underground: A station in which the major portions of the structure, including the tracks and platforms, are located below the finished grade and are totally enclosed. Also called a subway station.

Transit Car, Rail Rapid: An electrically propelled passenger carrying rail vehicle characterized by high acceleration and braking rates for frequent stops, and fast loading and unloading.

Tunnel: A totally enclosed trainway section which exceeds six hundred (600) feet in length.

ARTICLE 2 - FIRE ALARM AND WARNING SYSTEM

SECTION 200.0 SCOPE

The provisions of this article shall control the design and installation of the fire alarm and warning systems for all new construction of rapid transit facilities.

200.1 GENERAL: Rapid transit stations shall be equipped with fire alarm devices and be protected by a local system connected to a city or town master box with contacts and a connection to a data gathering panel in the station central instrument room for transmission of the alarm signal to Central Control. (See Article 12 of the Basic Code.)

SECTION 201.0 FIRE ALARM ANNUNCIATOR PANEL

Rapid transit stations shall be provided with a fire alarm annunciator panel, located at a suitable location approved by the local fire department. The main fire alarm panel shall announce by audible alarm the activation of any fire detector or pull station. The annunciator panel shall visually display the fire zone in which the initiating alarm device is located.

201.1 FIRE MANAGEMENT PANEL (FMP): Rapid transit subway stations shall be provided with a Fire Management Panel (FMP). The FMP shall be located at a suitable location approved by the local fire department. The FMP is designed to function as a fire command post in an emergency. It shall have means to tie into the public address system to provide fire department communications with passengers for specific directions in case of fire or emergency (See Section 207.0). A direct connection to the rapid

transit dispatcher shall also be provided for train control or power shut-off.

SECTION 202.0 FIRE ALARM DEVICES

Fire alarm devices shall be installed as follows:

a) Electrical Rooms - smoke detectors with alarm indication.

b) Central Instrument Rooms (CIR), Emergency Control Rooms (ECR), and Communications Rooms - smoke detectors with alarm indication and an automatic halon extinguishing system.

c) Mezzanine, concession areas, corridors, mechanical and toilet rooms, porter's rooms, and rooms used infrequently - rate of rise heat detectors.

d) Pull stations shall be provided at station entrances, platform areas, and at the fare collection area. Pull stations shall comply with NFPA 72B, Article 310. All locations shall be approved by the local fire department having jurisdiction.

e) Combination light and horn units located in public areas shall time out and silence the horn unit after two or three minutes. All visual alarm devices shall remain "ON" until the system is reset.

SECTION 203.0 SYSTEM TYPE

The fire detection and alarm system shall be supervised electrically. Trouble indication shall be located at the primary collector's booth and at Central Control.

The system shall have an approved secondary source of power.

SECTION 204.0 MUNICIPAL CONNECTION

A direct tie shall be provided from the rapid transit station master box to the local fire department headquarters in accordance with NFPA 72B.

SECTION 205.0 TRANSIT SYSTEM CONNECTION

A direct tie to Central Control shall be provided via a Data Gathering Panel.

SECTION 206.0 FIRE DEPARTMENT RADIO

Each rapid transit station shall be equipped with a base radio station connected to the local fire department headquarters for use by the fire department during emergencies as described in Article 3 - Communications.

SECTION 207.0 PUBLIC ADDRESS SYSTEM

Each rapid transit station shall be equipped with a public address system to provide communication with passengers in the event of a fire or emergency as described in Article 3 - Communications.

ARTICLE 3 - COMMUNICATIONS

SECTION 300.0 SCOPE

The provisions of this article shall control the design and installation of the communications systems for all new construction of rapid transit facilities.

300.1 GENERAL: The rapid transit system of the MBTA requires radio and wire subsystems for emergency use.

SECTION 301.0 RADIO SUBSYSTEMS

Radio subsystems for operational control, MBTA police, and local fire departments shall have the capability to cover all of the rapid transit stations and trainways, including above ground, subways and storage yards, with radio frequency signals. Radio coverage in the underground section for the above systems will be accomplished using a slotted coaxial cable (lossy line).

301.1 FIRE DEPARTMENT RADIO: Each local fire department along the route of the rapid transit system requires separate, though similar, tunnel coverage within its respective city or town limits using portable receivers. These fire departments will require base stations.

301.2 MBTA POLICE RADIO: The MBTA Police Department requires a full subway trainway and station coverage channel using portable transceivers and necessary base stations.

SECTION 302.0 WIRE SUBSYSTEMS

All land line channels shall be carried on physical telephone cable pairs. The treatment and termination of these pairs, including the use of carrier channels, and the installation of the cable and its terminal equipment shall conform to general practices and the MBTA Standards.

SECTION 303.0 PUBLIC ADDRESS

The MBTA Rapid Transit Dispatcher located at Central Control shall be provided with a system to address passengers directly, when necessary, and there shall be provided a voice grade, DC signal, zero dbm channel for each individual transit station public address destination.

303.1 STATION REQUIREMENTS: For purposes of rapid transit station operation, each station shall require a public address system in accordance with MBTA standards.

SECTION 304.0 PRIVATE AUTOMATIC EXCHANGE (PAX) TELEPHONES

There shall be provided common battery off-premise local stations connected to the existing line switching machine located at the MBTA Central Control. These locals shall include PAX telephone instruments at specific locations.

304.1 STATION TELEPHONES: For purposes of rapid transit operation, PAX telephone stations shall be installed in the starter's room at each station. The telephone sets in these locations shall be key sets that will accomodate an individual PAX line, an emergency telephone connection, and access to

each of the station public address zones in the station.

SECTION 305.0 EMERGENCY TELEPHONES IN TUNNELS

The MBTA shall require emergency telephone sets installed at a maximum interval of one thousand (1,000) feet along each subway trainway. Locations shall include cross passages, vent shafts, turnouts and cross-overs, and platform ends. The telephone instrument at each location shall include the handset, subset, enclosure with instructions for use, visible identifier code, and blue light locator.

305.1 INSTALLATION: The emergency telephone circuit shall provide for common battery operation without outward signaling, but with automatic signaling to Central Control when "off-hook".

305.1.1 Emergency telephone channels shall be provided between Central Control and each rapid transit station. These channels shall be extended, but not in the inter-stations cable, from each station in all trainways through the line sections toward both adjacent stations. Alternate emergency telephone stations in each trainway shall be connected to alternate emergency telephone circuits (the dual cable plan extensions within each trainway). Telephone set connections to the same channel shall be multiple with common access to supervisory at Central Control.

305.1.2 Each local emergency telephone station shall require a connection also to a PAX line.

SECTION 306.0 DATA CHANNELS

Channels shall be provided to accomodate several data trans-

mission systems.

306.1 SIGNAL SYSTEM: The signal system shall include a supervisory data transmission system.

306.1.1 Two voice grade, duplex channels, without signaling, shall connect master terminals at Central Control with remote terminals in the Central Instrument Room (CIR) in each rapid transit station.

306.1.2 There shall be provided a dedicated channel to each rapid transit station with access to standby channels in the event of failure in any link of the normal channel.

306.1.3 The signaling supervisory digital data transmission system shall communicate controls and indications for remote operation of the signal system, the ventilation system, the sump pumps and various alarms from the field to the support facility monitor at Central Control.

306.2 POWER SYSTEM: The power system shall include a supervisory and telemetry data transmission system, using a separate complement of master and remote terminals.

306.2.1 A voice grade, duplex channel, without signaling, shall connect master terminals located at Central Control with remote terminals in the Central Instrument Room (CIR) in each rapid transit station.

306.2.2 There shall be provided a dedicated channel to each station with access to standby channels in the event of failure

in any link of the normal channel.

306.3 FIRE AND INTRUSION SYSTEM: The fire and instrusion system shall be a separate data transmission system which includes a central processor that buffers and decodes data from the field.

306.3.1 A voice grade, duplex channel, without signaling, shall connect a master terminal located at Central Control with remote fire and intrusion terminals located in each rapid transit station.

306.3.2 There shall be provided a dedicated channel to each station with access to standby channels in the event of failure in any link of the normal channel.

SECTION 307.0 CLOSED CIRCUIT TELEVISION

Empty conduit systems shall be provided for future equipment.

SECTION 308.0 MBTA POLICE TALK BACK SPEAKERS

On each rapid transit platform, there shall be MBTA police talk back speakers in a box convenient for passenger use.

SECTION 309.0 COMMUNICATIONS ROOM

There shall be a communications room in each rapid transit station located at the platform level separate from, but close to, the Central Instrument Room. Each communications room will contain both the system and the local rapid transit

station communications equipment, cabling and accessories.

309.1 MECHANICAL REQUIREMENTS: See Section 403.2 of this code.

ARTICLE 4 - VENTILATION

SECTION 400.0 SCOPE

The provisions of this article shall control the design and construction of the ventilation systems for all new construction of rapid transit stations and tunnels.

400.1 GENERAL: The objectives to be achieved by the ventilation systems in the rapid transit stations and tunnels are as follows:

a) To provide and maintain egress routes from the stations and tunnels reasonably clear of smoke and heat in the event of an emergency.

b) To provide a sufficient current of air which would indicate to individuals the direction of egress.

c) To remove smoke in order to assist passengers, employees and fire fighters.

Underground rapid transit stations and tunnels shall be ventilated by using the action of the moving trains, called piston action, or, if required, by power-driven fan systems or by a combination of both methods. As a minimum, the following mechanical ventilation systems shall be provided:

a) Underplatform exhaust and platform supply systems.

b) Intermediate tunnel fan shaft ventilation systems

All stations shall provide ventilation in ancillary areas as indicated in a later section of this article.

SECTION 401.0 CODES AND STANDARDS

Except as modified hereunder mechanical installations and

materials shall conform to the applicable sections of the latest editions of the following codes and standards:

a) National Fire Protection Association

b) Massachusetts State Building Code

c) ASHRAE Guide

d) Massachusetts Bay Transportation Authority Standards

e) American National Standards Institute

f) OSHA

SECTION 402.0 CONTROLS

The controls for normal operation of heating, ventilating and air conditioning (HVAC)equipment shall be as simple as practical and consistent with energy conservation. (See Article 20 of the Basic Code.) In addition, the controls of the ventilation equipment available for use in emergencies shall meet the requirements of both the MBTA and the local fire departments.

SECTION 403.0 UNDERGROUND STATIONS

In this section, heating, ventilating and air conditioning will be considered together. The HVAC systems for the underground (subway) stations shall provide a suitable environment for passengers, operating personnel and employees in any concession area.

403.1 BASIC REQUIREMENTS: When control of heat in underground stations is indicated, the temperature shall be limited to seventeen (17) degrees Fahrenheit above the outside ambient

or a maximum of one hundred five (105) degrees Fahrenheit. Short peaks of higher temperature may be allowed. The temperature limitations shall be achieved by train induced air flow through ventilation shafts, platform supply and underplatform exhaust systems and intermediate tunnel vent shaft and fan ventilation systems.

403.1.1 Station ventilation systems shall be designed to aid in maintaining egress routes clear of heat and smoke in the event of an emergency. The ventilation system shall have the capability of sweeping with fresh air the open stairways and escalators available to passengers to enable them to be used as emergency egress exitways. Adjustable openings, if required, may be provided in certain locations in the station complex to enable this system to function effectively.

403.1.2 Any heating added to the stations shall be by means of electricity.

403.2 ANCILLARY SPACES: In all rooms or areas, the heating, ventilating and air conditioning requirements of the Basic Code shall be met, except as follows or as may be required by the MBTA:

a) Battery rooms shall be equipped with a mechanical fan which will exhaust air from a location near the ceiling. The fan shall be adequate to provide ventilation that will limit the hydrogen concentration to no more than three (3) percent at the maximum charge rate. Provision shall be made to maintain a minimum temperature of forty (40) degrees Farenheit.

b) Emergency generator rooms shall have provisions to supply one hundred (100) percent of the required air from the outside when the generating unit is in operation and to exhaust directly to the outside atmosphere.

c) Communications rooms shall have positive, clean air pressurization, and temperature and humidity control. A loss of positive pressure, momentary or steady-state, shall cause an alarm to annunciate the loss at Central Control.

403.3 UNDERPLATFORM VENTILATION: At high platform subway stations, excess heat shall be exhausted to the outside by means of an underplatform ventilation system. The system shall be capable of removing a minimum of one hundred twenty-five (125) cubic feet of air per minute (CFM) per linear foot of station platform edge at trackside through adjustable openings located under the overhang of the platform. Unfiltered make-up air of an equal or greater volume, drawn from an outside source, shall be supplied by means of reversible fans located within the station complex.

403.4 ENCLOSED EMERGENCY EXIT STAIRWAYS: An enclosed emergency exit stairway from a platform which is located at an elevation greater than thirty (30) feet below the level of the exit to the outside or is located under another station platform or tunnel shall be required to be made smokeproof.

403.4.1 These enclosed emergency exit stairways shall be made smokeproof by providing a mechanical exhaust or supply/exhaust system which will supply outside air of sufficient capacity so as to prevent the intrusion of smoke or remove intruding smoke before such smoke can travel further than one-half flight of

stairs up the exit stairway. Supply air shall be introduced far enough above entry level to ensure a flow of smoke-free air into the faces of persons exiting from the platform and/or mezzanine levels. The specific system proposed shall be reviewed with the MBTA and the MDPS prior to incorporation into the design of a station.

403.4.2 The emergency exit stairway ventilation system shall have adequate controls and switches for either manual or automatic activation of the system or both as local conditions indicate.

403.4.3 The standby power required in Section 618.9.4 of the Basic Code may be provided by the dual feeder system complex as described in Article 5 of this document.

SECTION 404.0 ABOVE GROUND STATIONS

In this section, heating, ventilating and air conditioning will be considered together. The HVAC systems for the above ground (depressed, surface and aerial) stations shall provide a suitable environment for passengers, operating personnel and employees in any concession area.

404.1 ANCILLARY SPACES: See Section 403.2 of this article.

SECTION 405.0 TUNNELS

405.1 BASIC REQUIREMENTS: Fans capable of producing a velocity of five hundred (500) feet per minute (FPM) in any of the adjacent segments of a tunnel (stations and tunnel expansions excepted) shall be provided. This velocity will supply fresh air to persons evacuating from the tunnel on foot and will indicate the direction of safety.

405.1.1 At the interface of the supply and exhaust air between the tunnel structures and the outside air, the velocity of the air due to either the piston action of the moving trains or the mechanical ventilation systems shall be limited as follows:

a) In areas accessible to the public, gratings installed at an angle less than forty-five (45) degrees to the horizontal and located from ground level up to within three (3) feet above ground level - 500 FPM.

b) In areas accessible to the public, louvers or gratings installed at an angle greater than forty-five (45) degrees above the horizontal with the bottom edge less than eight (8) feet above the contiguous ground level - 500 FPM.

c) In locations contiguous to areas accessible to the public, louvers and gratings installed at an angle of forty-five (45) degrees or less above the horizontal with the bottom edge three (3) feet or higher above the contiguous ground level - 1,000 FPM.

d) In areas accessible to the public, louvers and gratings installed at an angle greater than forty-five (45) degrees above the horizontal with the bottom edge eight (8) feet or higher above the contiguous ground level - 1,000 FPM.

e) Other louvers and gratings have no restrictions.

f) In an emergency, the limits of the velocities through the openings listed above in this section shall not apply.

405.2 FAN EQUIPMENT: The entire fan assembly of blades, bearings vanes, motors, wiring, housing, etc. shall withstand and operate

in a three hundred (300) degrees Fahrenheit temperature for a minimum period of one (1) hour.

405.3 NOISE CONTROL: Excess noise and vibration associated with the tunnel ventilation system shall be attenuated to meet the latest requirements of all applicable codes and standards.

SECTION 406.0 INTERNAL COMBUSTION TRACTION POWER EQUIPMENT

In stations and tunnels in which internal combustion traction power equipment operates (such as diesel-electric locomotives or rail cars) special ventilation shall be provided, if required, to reduce any contamination to a safe level according to the latest applicable codes and standards.

ARTICLE 5 - ELECTRICAL

SECTION 500.0 SCOPE

The provisions of this article shall control the design and installation of the electrical systems for all new construction of rapid transit stations and tunnels.

500.1 GENERAL: The rapid transit system electrical loads are served with either alternating current (AC) or direct current (DC). AC power serves the station and auxiliary loads. DC power provides the energy to drive the motors on the transit vehicles using a third rail or overhead wire system for the supply and the running rails for the return.

SECTION 501.0 CODES AND STANDARDS

Electrical installations and materials shall conform to the applicable sections of the latest editions of the following codes and standards:

a) National Fire Protection Association
b) Massachusetts Electrical Code 527 CMR 12.00
c) National Safety Code
d) Association of American Railroads
e) Association of Edison Illuminating Companies
f) Institute of Electrical and Electronic Engineers
g) Insulated Power Cable Engineers Association
h) Massachusetts Bay Transportation Authority Standards
i) American National Standards Institute

SECTION 502.0 STATION POWER

AC power is distributed from a double ended unit substation

which serves electrical loads for lighting, escalators, elevators, heating and ventilation equipment, pumps, communications and signal equipment.

502.1 UNIT SUBSTATIONS: Unit substations are served from available utility company electrical systems or available MBTA power sources.

SECTION 503.0 STATION EMERGENCY POWER

503.1 GENERATOR: An engine generator set shall be the main source of power during failure of the normal power supply to the transit station. The engine generator shall be of sufficient capacity and rated for continuous standby service for the station auxiliary loads, signal and communications equipment, and emergency lighting, and shall have the provision for automatic starting when the normal power supply fails.

503.1.1 Noise pollution level requirements of applicable codes shall govern the operation of the emergency generator unit.

SECTION 504.0 STATION EMERGENCY LIGHTING

504.1 BATTERY INVERTER UNITS: In addition to the emergency generating unit, battery inverter units shall be provided to automatically maintain station emergency lighting units during the time interval when the normal utility power fails and the emergency generator unit starts and is able to serve the emergency lighting load. The batteries for the inverter

system shall be rated for a minimum of one and one-half (1½) hours of operation.

505.0 TRACTION POWER

DC power is provided by means of 1,000 volt feeders from the traction substation DC switchgear.

505.1 TRACTION POWER SYSTEM: The traction power system shall include the primary AC switchgear, rectifying transformers, rectifier units and the output network including DC switchgear, 1,000 volt class positive feeders, contact rails or overhead wires, trackside switches and all accessories.

SECTION 506.0 EMERGENCY SWITCHES

Switches shall be installed that will de-energize traction power circuits in an emergency.

506.1 "B" SWITCH: A manually operated, normally closed disconnect switch (called a "B" switch) shall control the traction power for the pit rail in the transit station. These switches shall be located in each station at the departing end (the motorman's position) of every station platform for each track.

506.1.1 New "B" or "BJ" switch design applications may have these switches in parallel-series at each end of the station platform.

506.2 "J" SWITCH: At every transit station, the contact rails (pit rails) shall be sectioned by normally open dis-

connect switches (called "J" switches). "J" switch applications will vary according to electrical design requirements peculiar to individual passenger stations.

SECTION 507.0 SIGNAL POWER

Power shall be provided especially for signaling and communications at each rapid transit station, or yard, where signaling and communications equipment will be located.

507.1 MODE: Mode of signal power, Normal, Standby or Emergency-Generator, shall be relayed to Central Control over the supervisory system.

507.2 COMMUNICATIONS EQUIPMENT STANDBY POWER. At both the MBTA and the fire department radio base stations, the power supply system shall include a twenty-four (24) hour standby battery and ancillary equipment to operate the base station radio equipment only, in the event of complete failure of the utility system and the standby engine generator.

SECTION 508.0 STATION LIGHTING

General illumination for the normal lighting system shall be served from the AC station electrical distribution system.

508.1 ILLUMINATION LEVELS: Levels of illumination shall conform to Table 5-1 below in accordance with the lighting provisions of Article 20 of the Basic Code.

TABLE 5 - 1 GENERAL ILLUMINATION LEVELS

AREAS	FOOTCANDLES - MAINTAINED
Administrative Staff Areas, Starter's Room, Fare Collection Booth, Communications Room, Central Instrument Room and Equipment Rooms	30
Bus Parking	3
Bus Loading Zone	10
Concession Area	30
Emergency Lighting at Station Platforms, Places of Egress, Stairways and Exits	4
Entrance Lobbies	30
Mechanical and Electrical Spaces	20
Outdoor Entrances to Escalators and Stairways	10
Outdoor Plazas	5
Pedestrian Tunnels and Passageways, Mezzanine Areas	40
Pedestrian Walkways	5
Stairways and Entrances	25
Station Platforms	20
Storage Rooms, Porter's Rooms	15
Toilets	30
Trackways and Tunnels (emergency and normal)	1.5
Waiting Areas:	
Interior	30
Exterior	15
Vending Area	40

Note 1 All footcandle levels shall be computed on a horizontal plane at the finished floor.

Note 2 Other areas not listed shall conform to the requirements of the Basic Code.

508.2 LIGHTING POWER LIMITS FOR RAPID TRANSIT SYSTEMS: The maximum power limit for interior and exterior illumination systems associated with underground and above ground rapid transit stations shall be as required in the Basic Code.

SECTION 509.0 TUNNEL LIGHTING

509.1 LIGHTING FIXTURES: Tunnels shall be illuminated with 480 volt AC fluorescent weatherproof fixtures, individually fused. Successive fixtures along the trackway shall be connected to alternate 480 volt three phase distribution lines.

509.1.1 The source of one distribution line shall be the secondary switchgear in the unit substation at the rapid transit station at one end of the line section. The source of the other distribution line shall be the secondary switchgear in the unit substation at the rapid transit station at the other end of the line section.

509.1.2 Lighting fixtures shall be mounted parallel to the trackway and spaced no more than forty (40) feet on center.

509.1.3 The entrance to an emergency exit, including cross passages, shall be indicated by one vertically mounted fluorescent lighting fixture.

509.2 WIRING: Insulated conductors on racks mounted on the tunnel walls shall be the wiring arrangement for the tunnel lighting.

SECTION 510.0 LIGHTING CONTROL: Adequate accessible switches and circuits shall be provided to promote energy conservation.

SECTION 600.0

The provisions of this article shall control the design and construction of all new rapid transit stations, tunnels and aerial structures and all new construction in existing rapid transit facilities.

600.1 GENERAL: Except as otherwise specified herein, all new rapid transit facilities shall conform to the requirements of the Basic Code for Type 1 (Fireproof) construction; Type 2 (noncombustible) construction or combinations of Type 1 and Type 2 construction.

SECTION 601.0 UNDERGROUND STATIONS

Building construction for the basic structural elements such as columns, bearing walls, beams and slabs over trainways for subway stations shall conform to the requirements for Type IB (fireproof) construction of the Basic Code.

601.1 ANCILLARY SPACES: See Section 603.0 of this Article.

601.2 STAIRS AND ESCALATORS: Stairs and escalators used regularly by passengers need not be enclosed, even though they may serve as emergency exit routes. (See Elevator and Escalator Regulations 524 CMR 3.00-11.00 and Elevator, Dumbwaiter, Escalator and Moving Walk Regulations.)

601.3 INTERIOR FINISH AND SPECIAL MATERIALS AND TRIM: All interior finish and acoustical and insulation materials used within the station shall be noncombustible or Class I with a smoke development rating not to exceed 50, as measured by ASTM E84.

602.0 ABOVE GROUND STATIONS

Building construction for the basic structural elements such as columns, bearing walls, beams and slabs over trainways for depressed (below-grade), surface (at-grade) and aerial (above-grade) stations shall be of noncombustible types of construction complying with the requirements of the Basic Code.

602.1 EXCEPTIONS: Where the platform or concourse exceeds the area limits of Table 305 of the Basic Code for the use group A-3 (assembly) and has only a roof above it, the walls and roof supporting structure may be:

a) Of one (1) hour protected construction of non-combustible materials when roof construction is less than twenty (20) feet above the platform or the platform or concourse is enclosed.

b) Of unprotected construction of noncombustible materials when the roof construction is more than twenty (20) feet above the platform and the station or concourse is open.

c) For a platform area to be considered "open" not less than twenty-five (25) percent of those enclosing walls which are parallel to the trackway shall be open with openings substantially uniformly distributed along both walls, except that platform areas not exceeding 600 feet in length with open ends shall be considered open.

d) For a concourse area to be considered "open", not less than three of its four enclosing walls shall have substantially uniformly spaced openings equal to not

less than twenty-five (25) percent of the total area of all of the enclosing walls. In no instance shall any of the three exterior walls be less than twenty-five (25) percent open.

602.1.1 For a platform or concourse area to be considered "open" in a depressed station where none of its enclosing walls contain any openings, the roof area above the enclosed trainways and platform or concourse shall have substantially uniformly spaced openings equal to not less than twenty-five (25) percent of the roof area. Automatic or operable roof vents complying with NFPA204 may be used to provide the required minimum opening percentage.

602.1.2 Aerial trainways and open platforms may be of unprotected construction of noncombustible materials unless located over combustible buildings, areas used for storage of highly combustible materials or other known hazardous locations.

602.2 ANCILLARY SPACES: See Section 603.0 of this Article.

602.3 STAIRS AND ESCALATORS: Stairs and escalators used regularly by passengers need not be enclosed, even though they may serve as emergency exit routes.

SECTION 603.0 ANCILLARY SPACES

In all stations, ratings of fire separations shall be maintained between occupancies as required by the Basic Code, except as follows:

a) All traction power substations shall be of three (3) hour fireresistive construction.

b) Switchgear and electrical control rooms, auxillary electrical rooms and associated battery rooms shall be of two (2) hour fireresistive construction.

c) Central Instrument Rooms, train control rooms and associated battery rooms shall be of two (2) hour fireresistive construction.

d) Trash and storage rooms shall be of two (2) hour fireresistive construction.

e) Enclosed concession and retail spaces shall be of two (2) hour fireresistive construction.

   1. Exception: Freestanding booths and kiosks shall be of noncombustible construction

f) There shall be a two (2) hour fireresistive separation between the ancillary (non-public) areas and the public areas.

   1. Exception: Agent's and information booths shall be of noncombustible construction.

g) Emergency exit passageway walls through the ancillary areas and the shafts, including the exit stairs, shall be of two (2) hour fireresistive construction.

h) All openings in fireresistive separations shall be enclosed with approved labeled protective assemblies as required in the Basic Code.

i) There shall be a three (3) hour fireresistive separation between all system public areas and all non-system (private) occupancies. All openings from system public areas to all non-system occupancies (i.e., private entrances) shall be protected with Class A, three (3) hour fire door assemblies. These doors shall be normally closed by positive means or operation

of the closures shall be by automatic means activated by products of combustion (such as ionization type) detectors and fusible links, or by fusible links only where a separate smoke barrier is provided.

SECTION 604.0 ALTERATIONS AND REPAIRS

When existing stations are altered or repaired, the full requirements of this rapid transit facilities code need not apply, except as provided in Section 106.0 of Article 1 and Article 22 of the Basic Code. However, all new work shall be made to conform to the requirements of this code.

SECTION 605.0 UNDERGROUND TUNNELS

605.1 CUT-AND-COVER: When tunnels are to be constructed by the cut-and-cover method, perimeter walls and related construction shall be of noncombustible construction.

605.2 DECK STRUCTURES: Construction of all continuous deck structures over the transit stations and trainways shall be of totally noncombustible materials. Where unusual conditions or excessive fire loads exist, construction conforming to Type 1 or Type 2 construction of the Basic Code or combinations of Type 1 and Type 2 shall be used.

605.3 TUNNELING: When line structures are to be constructed by mine tunneling methods, unprotected steel or cast-iron liners, reinforced concrete liners, shotcrete or the equivalent shall be used. Rock tunnels may utilize steel bents with a concrete liner if a lining is required. Walkways designated for evacuation of passengers shall be of non-

combustible construction.

605.4 UNDERWATER TUBES: Noncombustible construction as defined by Table 214 of the Basic Code shall be used as applicable. Ancillary areas within tubes shall be separated from trackway areas by fire separations as required by Section 603.0 Ancillary Areas.

606.0 BRIDGE STRUCTURES

606.1 FIRE PROTECTION: Where an existing or new bridge structure is located within a deck structure in a station area only noncombustible materials may be used. Consideration shall be given to the use of fire resistive construction where conditions indicate excessive build up of heat from serious fire conditions, or total inaccessability for fire fighting exists and the bridge structure is considered to be in an unventable location.

SECTION 607.0 OTHER CONSTRUCTION

607.1 SHAFT TERMINATIONS: To limit the entrance of a hazardous liquid, there shall be no grates for fan or vent shafts or other openings terminating in vehicular travelways except as specified below in Section 607.1.2.

607.1.1 Vent and fan shafts and other openings may terminate in median strips of divided travelways or in sidewalks designed to accept such openings, or in open space areas, provided that the grade level of the median strip or sidewalk, or open space, is higher than the level of the adjacent vehicular travelway and separated by a minimum six (6) inch high concrete or stone curb.

607.1.2 Where conditions of construction are such that it is impossible to avoid locating the gratings or other openings in a vehicular travelway, gratings may be permitted in a vehicular travelway provided that a drainage trough is installed to immediately intercept the flow of any liquids onto the grating area.

Further an interceptor shall be installed at the bottom of the vertical shaft to intercept any liquids spilled directly onto the gratings. The trough will connect into the local surface drainage system and the interceptor shall drain through a gasoline trap into the subway drainage system.

ARTICLE 7 - MEANS OF EGRESS

SECTION 700.0 SCOPE

The provisions of this article shall control the design, construction, and arrangement of building elements required to insure safe means of egress from all new rapid transit stations, tunnels and aerial structures.

700.1 GENERAL: This article includes all new rapid transit stations and trainways whether they be located entirely or in any part underground or above ground. Every station or trainway section, or area thereof of such size, occupancy, and arrangement that the reasonable safety of numbers of occupants may be endangered by the blocking of any single means of egress due to fire or smoke shall have at least two means of egress from the affected area remote from each other, so arranged as to minimize any possibility that both may be blocked by any one fire or other emergency conditions. (See Article 6 of the Basic Code and NFPA 101.)

SECTION 701.0 STATION EXITING

701.1 OCCUPANCY: The primary purpose of a rapid transit station is for the use of rapid transit patrons who would normally stay in a station structure for a period of time no longer than that necessary to wait for and enter upon a departing rapid transit vehicle, or to depart from an arriving rapid transit vehicle.

701.1.1 Occupancy shall also include MBTA employees whose work assignments require their presence in the station structures and persons employed in any concession area.

701.2 OCCUPANCY LOAD: The occupancy load for a rapid transit station shall be established based on the net usable area of the station platform, deducting the space occupied by structural elements, stairs, escalators, elevators, concession and service spaces, furnishings and the eighteen (18) inch wide platform edge safety stripe.

701.2.1 An occupancy load of one (1) person per seven (7) square feet of net usable area of the station platform shall be used to calculate the passenger loading for any platform which serves a rapid transit line.

701.2.2 An occupancy load of one (1) person per two (2) linear feet of station platform edge at trackside shall be used to calculate the passenger loading for any platform which serves only a commuter and/or an intercity railroad.

701.2.3 Any uncovered portion of a station platform need not be included in the calculation of the occupancy load of a station, and may be considered an area of safety when clearly designated.

701.3 TRAVEL DISTANCE: The maximum travel distance from any point on the platform to an exit, to an area of safety, or to an area of refuge, shall not exceed three hundred (300) feet, including any length of travel on a stair or escalator.

701.3.1 An area of safety is defined as an open space of Type 1 or Type 2 construction with ceilings over twenty (20) feet high with adequate natural or mechanical ventilation. It shall be clearly designated as an area of safety in case of fire.

Directional signs indicating the direction to the area of safety shall be provided where the direction of travel to reach the area of safety is not immediately apparent.

701.3.2 An area of refuge is defined as a sprinklered area along an exit path protected on all sides by two (2) hour rated walls, and one and one-half (1½) hour Class B doors. It shall be clearly designated as an area of refuge in case of fire. Directional signs indicating the direction to the area of refuge shall be provided where the direction of travel to reach the area of refuge is not immediately apparent. Provisions shall be made for smoke control.

701.3.3 At a station where the trainway is open at or near the end of the station platform, including depressed, surface and aerial stations, said open trainway may be considered as an area of safety, provided that such use will take place only under the guidance and control of authorized MBTA personnel or by other authorized personnel as warranted under an emergency situation, and that it shall first be positively established that the contact rail traction power circuits have been de-energized . At the ends of this platform, forty-four (44) inch wide gates and stairs shall lead to the trainway.

701.3.4 Any area of safety or any area of refuge, as defined in Sections 701.2.3, 701.3.1 and 701.3.2 of this Article, may be considered as providing safety for one (1) person per seven (7) square feet of net usable area.

701.4 UNIT OF EXIT WIDTH (UEW): Means of egress shall be measured in units of width of twenty-two (22) inches. Fractions of a unit shall not be counted except that twelve (12) inches added to one (1) or more full units shall be counted as one-half (½) a unit of exit width. (See Section 608.1 of the Basic Code). Width shall be measured in the clear at the narrowest point except that individual handrails may project three and one-half (3½) inches into the required width. Stringers may also project one and one-half (1½) inches into the required width. (See Section 616.0 of the Basic Code.) Exception: See Section 701.9 of this Article.

701.5 DESIGN CAPACITY ALLOWANCE: The exiting capacity per unit of exit width of a stair or escalator or ramp of over four (4) percent slope shall be limited to seventy-five (75) persons. The capacity per UEW of level or horizontal exits including doors and gates, or ramps of four (4) percent slope or less shall be limited to one hundred (100) persons. The capacity per UEW of a turnstile shall be limited to fifty (50) persons.

701.6 MINIMUM HORIZONTAL EXITWAY WIDTHS: Exitway corridors and ramps of four (4) percent slope or less shall be a minimum of sixty-six (66) inches wide.

701.6.1 All ramps required as a means of egress for the handicapped shall comply with the requirements of the Rules and Regulations of the Architectural Barriers Board.

701.7 MINIMUM VERTICAL EXITWAY WIDTHS: Exitways shall be provided from the station platform to grade level with no

reduction in exit width unless specifically excepted by the state inspector.

701.7.1 Exit doors shall be class B, one and one-half (1½) hour labeled assembly forty-four (44) inches wide equipped with panic hardware in accordance with Section 612.5 of the Basic Code. (This door width is required to accommodate stretchers and a fully equipped fireman using breathing apparatus.)

701.7.2 Exit stairs shall be a minimum of sixty-six inches wide, excluding those leading to the trainway. The stairway shall be designed in accordance with Section 616.0 of the Basic Code.

701.7.3 Exit ramps of over four (4) percent slope shall be a minimum of sixty-six (66) inches wide.

701.7.4 Escalators shall be considered as conforming exit stairs for the purpose of exit capacity calculations. A thirty-two (32) inch wide escalator shall count as one (1) UEW and a forty-eight (48) inch wide escalator shall count as two (2) UEW. In the event of an emergency, incoming escalators shall be stopped by the station attendant.

701.7.5 Elevators throughout all stations shall not be considered a means of egress in determining the exitway capacity. They shall be equipped with controls which will offer special provisions for operation by the fire department including selective stopping and override capability. To prevent entrapment in an elevator during a fire, each elevator shall be equipped with an intercom

connected to the primary collector's booth. This "call for aid" system shall be served by the emergency power system if normal power fails.

NOTE: 701.8 ESCALATORS (SEE PAGE 7-6A) NEXT PAGE

701.8.5 Escalators may be operated at any speed approved by ANSI A17.1.

701.9 FARE COLLECTION GATES: The following design features shall be provided to permit ample exits if an emergency should occur:

a) Fare aisles shall assume an emergency exit mode in the event of a power failure, or by activation of a manual or remote control.

b) At least one gate-type exit thirty-eight (38) inches high and forty-four (44) inches wide which swings in both directions shall be provided at each fare collection array.

c) A turnstile fare collection gate of minimum eighteen (18) inch aisle and maximum thirty-six (36) inch height of the turnstile bar which when deactivated will free wheel in the exit direction may be considered as an emergency exit and shall count as one-half (½) a horizontal UEW.

701.10 GATES AND DOORS: Gates and doors that are used to protect a station and are necessary for use as an emergency egress shall be able to be opened either by remote control from a location that is continuously attended while the station is open or by panic hardware which will activate any latches or locks.

701.8 ESCALATORS: All of the provisions of Section 620.0 of the Basic Code shall apply except the vertical travel height of escalators in transit stations may exceed the limits given in Section 620.7.3 providing additional safety features are included. The number of flat steps at the upper landings shall be increased according to the vertical rise of the escalators. Escalators up to a twenty (20) foot rise shall have a minimum of one and three-fourths (1-3/4) flat steps, those with a rise over twenty (20) feet shall have a minimum of two (2) flat steps.

701.8.1 Landing and floor plates exposed to the outdoor environment shall be covered with an approved slip-resistant material.

701.8.2 Understep lighting near comb-plates or other means of illuminating the comb-plates shall be provided.

701.8.3 Upthrust switches shall be provided at the upper and lower radii.

701.8.4 A flashing light and horn located in the collector's booth shall indicate that an escalator has stopped because of the activation of a safety device or other unusual condition. Also located in the collector's booth shall be an emergency stop button so that the station attendant can stop any escalator in the event of an emergency. If roll down grilles or doors are installed at escalator head houses, interlocks must be provided so that escalators cannot operate if grilles or doors are closed, to prevent the pile up of passengers against grilles or doors.

SECTION 702.0 TUNNEL EXITING

702.1 OCCUPANCY: It is anticipated that MBTA passengers will enter upon the tunnel trainways (subways) only in the event it becomes necessary to evacuate a disabled train. Such evacuation will take place only under the guidance and control of authorized MBTA personnel or by other authorized personnel as warranted under an emergency situation. In all cases, however, it shall first be positively established that the contact rail traction power circuits have been de-energized by MBTA personnel or by other authorized personnel.

702.2 EXITWAY DETAILS: Exitways shall be provided from tunnels to a point of safety. In a tunnel, a point of safety shall be defined as any one of the following:

a) an enclosed fire exit that exits to a public way or safe location outside the tunnel structure,

b) an at-grade point beyond any enclosing structure,

c) or other passage that affords adequate protection from smoke and fire for a passenger.

702.2.1 Along one wall of each tunnel a safety walk with a minimum width of twenty-four (24) inches shall be constructed a maximum of twelve (12) inches above the top of the adjacent running rail. The function of the safety walk is to enable passengers to detrain and walk to the nearest station, emergency stairway or other area of safety.

A continuous handrail shall be wall mounted forty-two (42) inches above the safety walk. In tunnels with safety niches, the handrail shall be interrupted for the width of the niche. The handrail shall not project more than three and one-half (3½) inches from the wall on which it is mounted and shall be designed to withstand an applied load of two hundred (200) pounds in any direction at any point. All handrails shall be returned to walls at each end of the handrail. The handgrip portion of a handrail shall not be less than one and one-quarter (1¼) inches nor more than two (2) inches in outside diameter and shall be basically round or oval in cross-section, and shall have a smooth surface with no sharp corners. Clearance between a wall and its wall handrail shall be one and one-half (1½) inches.

702.2.2 Emergency exit stairways shall be provided throughout the tunnels, spaced so that the maximum distance between emergency exits shall never be greater than twenty-five hundred (2500) feet. The stairways shall be designed in accordance with Section 616.0 of the Basic Code. The stairways shall be enclosed and shall lead directly to the outdoors, or to a safe refuge area.

702.2.3 Where trainways are divided by minimum two (2) hour rated firewalls, or trainways are in twin bores, such an arrangement shall be deemed to afford adequate protection for the passengers via cross passages between the trainways

and may therefore be utilized in lieu of exit stairways to the surface, or in the event that a ventilation system does not provide a sufficient stream of fresh air to protect the passengers in a path of egress, provided that:

a) Cross passages are no further than six hundred (600) feet apart and a minimum of seventy-two (72) inches wide.

b) Cross passages have at each end a set of Class B labeled assembly double egress doors. Both doors of each set shall be not less than thirty-six (36) inches wide and each door shall swing in the opposite direction from its mate.

c) Cross passages will contain an emergency telephone, and portable fire extinguishers as directed by the local fire department.

d) A system of positive ventilation satisfying air velocity criteria of this code is maintained in the uncontaminated trainway.

e) A ventilation system for the contaminated tunnel is capable of removing smoke from the vicinity of the passengers.

f) A suitable means of evacuating passengers in the uncontaminated trainway, for protecting passengers from oncoming traffic, and for evacuating passengers to a nearby station or other emergency exit is provided.

702.2.4 Doors to all tunnel exit access points shall swing in the direction of exit travel and shall be Class B, one

and one-half (1½) hour labeled assembly forty-four (44) inch wide doors equipped with panic hardware in accordance with Section 612.5 of the Basic Code.

702.2.5 Exit hatches at exit discharge points shall be protected by covers and shall be latched with UL listed panic hardware. Each separate leaf, if more than one, shall be independently operated so that with minimal effort the leaf can be released and opened. Hatch covers shall be capable of being opened from the outside by authorized personnel. The areas into which the hatches exit shall be designed to minimize obstruction of the hatches and maintain safe egress by approved guard rails if practical. The hatch areas shall be maintained obstruction free.

SECTION 703.0 SURFACE EXITING

703.1 OCCUPANCY: It is anticipated that MBTA passengers will enter upon the surface (at-grade) and depressed (below-grade) trainways only in the event it becomes necessary to evacuate a disabled train or evacuate a station platform. Such evacuation will take place under the guidance and control of authorized MBTA or other authorized personnel as warranted under an emergency situation. In all cases, however, it shall first be positively established that the contact rail traction power circuits have been de-energized by MBTA personnel or other authorized personnel.

703.2 EMERGENCY ACCESS AND EGRESS: Access gates, which are usable by the fire department for entering the trainway for emergency purposes, shall be provided in the security fences adjacent to the trainway. These gates shall also be used as emergency egress for passengers.

703.2.1 The gates shall generally be spaced at intervals not to exceed twenty-five hundred (2500) feet with a gate as close as practical to the portals to permit easy access to tunnels.

703.2.2 The gates shall be a minimum of forty-four (44) inches wide and shall be of the hinged or sliding type, and secured with a standard MBTA lock.

703.2.3 At the location of each gate in a depressed (below-grade) trainway, an unenclosed exit stairway to grade, a minimum of forty-four (44) inches wide, shall be provided.

SECTION 704.0 AERIAL EXITING

704.1 OCCUPANCY: It is anticipated that MBTA passengers will enter upon the aerial (above-grade) trainways only in the event it becomes necessary to evacuate a disabled train or evacuate a station platform. Such evacuation will take place under the guidance and control of authorized MBTA personnel or by other authorized personnel as warranted under an emergency situation. In all cases, however, it shall first

be positively established that the contact rail traction power circuits have been de-energized by MBTA personnel or other authorized personnel.

704.2 EMERGENCY ACCESS: Access to the aerial trainway shall be from the rapid transit station or by mobile ladder equipment from roadways adjacent to the trainway. If no adjacent or crossing roadways are available, access ways at intervals not to exceed twenty-five hundred (2500) feet shall be required.

704.2.1 If security fences are used along the trainway, gates shall be required as described in Section 703.2 of this code. Fences should not be in close proximity to the contact rail and/or overhead power and should be grounded at each post and to the fence mesh.

704.3 EMERGENCY EGRESS: There shall be a walkway or other suitable means for passengers to evacuate a train at any point along the trainway to either proceed to the nearest station or point of egress or wait for an evacuation train to arrive.

SECTION 705.0 SIGNING AND GRAPHICS

The signing and graphics within the rapid transit stations and trainways shall clearly mark exit routes. (See Section 623.0 of the Basic Code.)

705.1 STATIONS: Illuminated emergency exit signs and directional signs shall be placed within the rapid transit stations at emergency passageways and stairs and over all doors to emergency stairways. (See Section 624.0 of the Basic Code.)

705.1.1 Principal passenger station entrances and exits that are clearly visible are not required to have illuminated exit signs and/or directional signs.

705.2 TUNNELS: Illuminated emergency exit signs shall be placed at all emergency cross passages and over all doors to emergency stairways. Graphics shall be provided to clearly identify the location of each emergency exit.

705.3 SURFACE AND AERIAL TRAINWAYS: Emergency access and egress gates shall be equipped with an emergency exit light. Graphics shall be provided to clearly identify the location of each exit.

ARTICLE 8 - FIRE FIGHTING FACILITIES

SECTION 800.0 SCOPE

The provisions of this article shall control the design, construction and installation of fire fighting facilities for all new rapid transit stations and tunnels.

800.1 GENERAL: Rapid transit stations and tunnels shall be equipped with fire fighting facilities and equipment to limit the spread of fire and to assist in the fighting of a fire in any of these structures.

SECTION 801.0 UNDERGROUND AND ABOVE GROUND STATIONS

All stations, including subway, depressed, surface and aerial structures shall be equipped with various fire fighting facilities.

801.1 STANDPIPE SYSTEM: A dry standpipe system shall be installed at each station platform. The station standpipe system shall not be connected to tunnel standpipe system; separate street connections shall be provided for each independent system.

801.1.1 Two (2) two and one-half (2½) inch accessible standard pipe valves shall be spaced at one hundred (100) foot intervals.

801.1.2 A street-level connection shall be provided to fill the standpipe system and shall be as required by the local fire department.

801.1.3 All connection points, both fill and draw-off, shall be equipped with threads that conform to the standards of the local fire department.

801.2 PLATFORM HOSE SYSTEM: A first aid fire fighting system with threads that conform to the standards of the local fire department shall be installed at each platform at all stations if required by the local fire department. It may use the domestic water system as a supply source and shall include one and one-half (1½) inch hoses of sufficient length to cover the entire station platform.

801.3 SPRINKLER SYSTEM: A sprinkler line, heat traced if necessary, with sprinkler heads located as directed by the local fire department shall be installed in all enclosed concession areas. The domestic water system may be used as the supply source if no more than twenty (20) sprinkler heads are installed. (See Section 1205.0 of the Basic Code.)

801.3.1 A water flow alarm valve with the alarm connected to the fire alarm supervisory panel and to Central Control shall be installed in the sprinkler line.

801.4 HALON SYSTEM: Central Instrument Rooms (CIR), Emergency Control Rooms (ECR) and communications rooms shall be provided with an automatic halon extinguishing system.

801.5 FIRE EXTINGUISHERS: Portable fire extinguishers shall be provided in electric rooms, CIR, communications rooms, starter's rooms and main collector's booths and as directed by the local fire department.

SECTION 802.0 TUNNELS

802.1 STANDPIPE SYSTEM: A dry standpipe system shall be installed in all tunnels and shall meet the provisions listed earlier in Section 801.1.

802.2 FIRE EXTINGUISHERS: Portable fire extinguishers shall be provided as directed by the local fire department.

ARTICLE 9 - EMERGENCY PROCEDURES, INSTRUCTIONS AND EQUIPMENT

SECTION 900.0 SCOPE

The provisions of this article shall require the formulation and implementation of emergency procedures, instructions, and equipment for the rapid transit system of the MBTA.

900.1 GENERAL: The Massachusetts Bay Transportation Authority (MBTA) shall provide various items of emergency equipment and shall develop and distribute operating procedures and/or instructions to provide guidance for its personnel in the event of an emergency.

900.2 ENDORSEMENT: The master set of emergency procedures and/or instructions and the lists of emergency equipment shall be reviewed and endorsed annually in the month of July by the chief operating officer, certifying that the equipment lists, procedures and/or instructions have been reviewed in light of current operating practices and procedures and are presently adequate. These items shall be subject to the review of the local fire department.

SECTION 901.0 EMERGENCY PROCEDURES

The emergency procedures shall address the following situations for both the subway and open areas of the rapid transit system:

a) Fire or suspected fire:

   1. In the right-of-way
   2. In rooms or areas of the right-of-way

3. In passenger areas of stations
4. In ancillary areas of stations.
5. Under a train.
6. In a train.

b) Injured or sick individuals:

1. In normal passenger areas of stations.
2. In ancillary areas of stations.
3. On the right-of-way
4. Under a train.
5. In a train.

c) Derailment.

d) Bomb threat.

e) Robbery.

f) Civil disturbance or riot.

g) Natural disasters such as floods, earthquakes, windstorms and snowstorms.

h) Power failure.

i) Volitile liquid entering the subway of various locations.

SECTION 902.0 EMERGENCY INSTRUCTIONS

The instructions shall include check lists for materials to be available at various locations in the rapid transit system. These lists shall include procedures for the checking and replacing of materials.

The instructions shall contain detailed procedural methods for reporting various emergencies.

The instructions shall include rules for both Central Control and employees of the rapid transit system to follow in handling certain emergency situations and principles to follow in other cases.

SECTION 903.0 EMERGENCY EQUIPMENT

Throughout the rapid transit system, various items of equipment shall be provided to extinguish small fires or to limit the spread of large fires and to assist in the evacuation of passengers in the event an emergency occurs.

Equipment items to be provided shall be determined by the MBTA and may include special ladders for evacuating passengers from trains, third rail testers and covers, stretchers, fire extinguishers and pails of sand.

The emergency procedures and/or instructions for use of this equipment shall be provided by the MBTA as indicated earlier in this section.

Reference Documents Applicable to MBTA Fire Protection and Life Safety Program

ACI 318-1977	Building Code Requirements for Reinforced Concrete (American Concrete Institute)
AISC - 1969	Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings (American Institute of Steel Construction)
NFPA 72 B-1974	Auxiliary Signaling Systems (National Fire Protection Association)
NFPA 101-1976	Code for Safety to Life from Fire in Buildings and Structures (National Fire Protection Association)
NFPA 220-1975	Standard on Types of Building Construction (National Fire Protection Association)
521 CMR 3.00	Rules and Regulations of the Architectural Barriers Board (Massachusetts Department of Public Safety)
524 CMR 3.00-11.00	Elevator and Escalator Regulations
524 CMR 15.00-33.00	Elevator, Dumbwaiter, Escalator and Moving Walk Regulations
527 CMR 12.00	Massachusetts Electrical Code (Mass. Department of Public Safety)
780 CMR 18.00	The Commonwealth of Massachusetts State Building Code

BLUE LINE MANUAL CATALOG FILE

CATALOG #	DESCRIPTION	DATE
1	MBTA - GUIDELINES & STANDARD	
	PART I GUIDELINES & PRINCIPALS	REVISED 1977
	PART IV COMPONENTS	REVISED 1977
	PART V GRAPHICS	REVISED 1977
	PART VI LIGHTING	REVISED 1977
	PART VII MATERIALS	REVISED 1977
	PART VIII ACOUSTICS	REVISED 1977
	PART IX SERVICE FACILITIES	REVISED 1977
	PART X SITE PLANING AN NEW STATIONS	REVISED 1974
	PART XI VENTILATION	REVISED 1977
2	MBTA - FIRE PROTECTION AND LIFE SAFETY PROGRAM a.k.a. BOSTON TRANSIT FACILITIES CODE (BTFC)	AUG. 21, 1981 FOURTH DRAFT